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THE METAL INDUSTRY

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THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER

ELECTRO-PLATERS REVIEW

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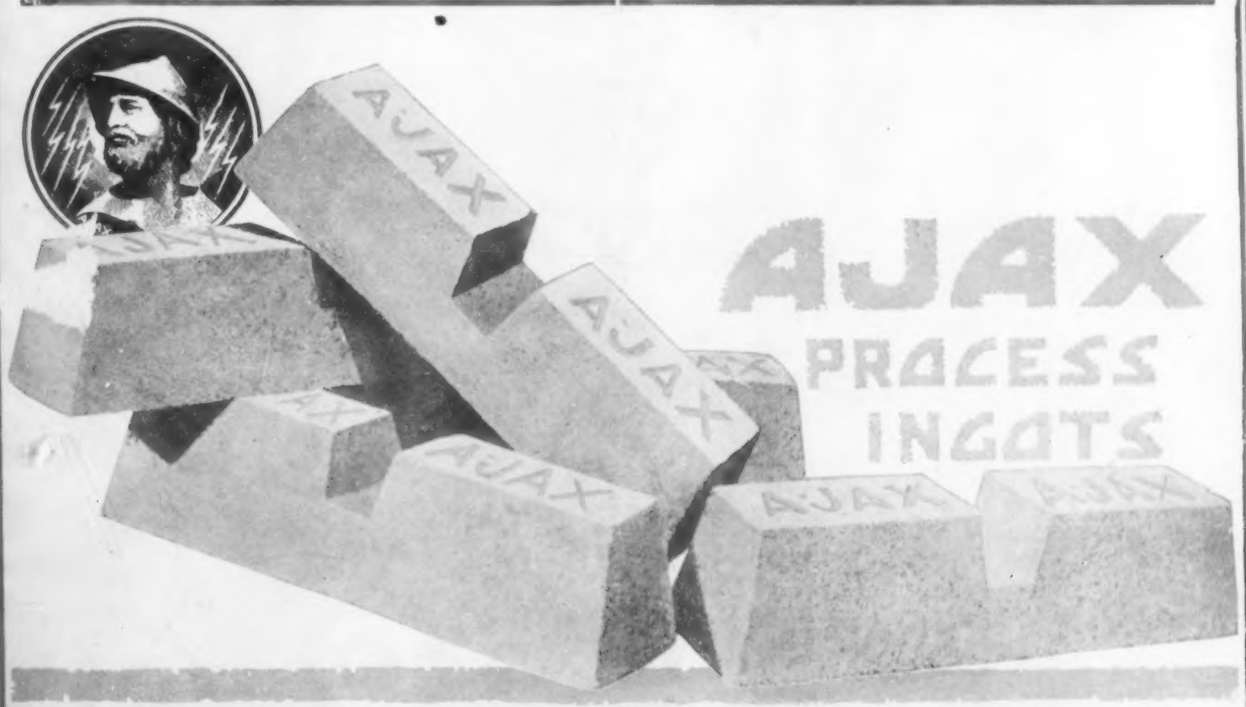

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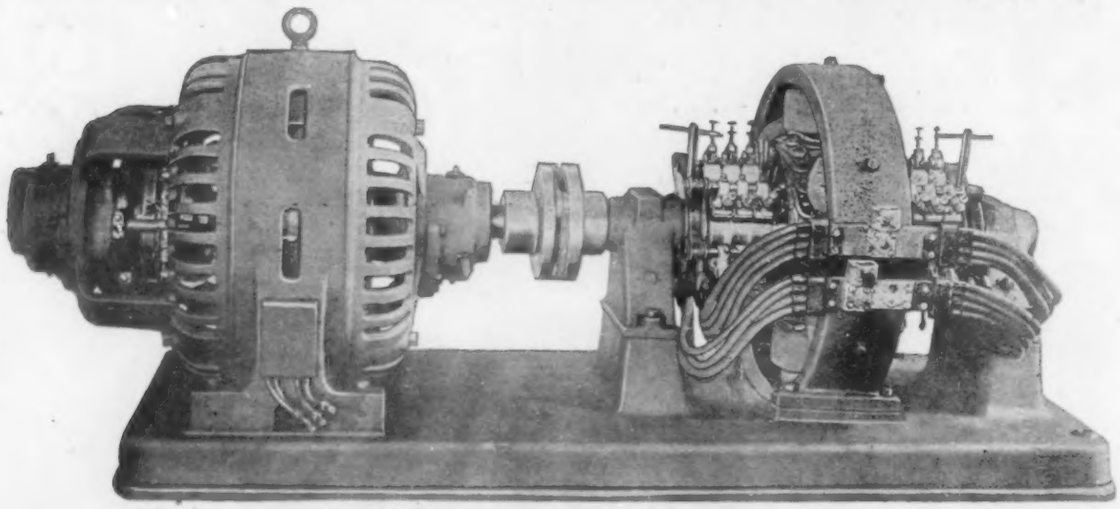

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ELECTRO-PLATERS REVIEW

Vol. 18 NEW YORK, OCTOBER, 1920 No. 10

The Metal Trades Convention

A Report of the Joint Meeting and Exhibition of Foundry Supplies and Machinery Held at Columbus, O., October 4-8, 1920, by the American Foundrymen's Association and the Institute of Metals Division of the A. I. M. E.

It seems to be a part of the regular routine of the American Foundrymen's Association to surpass its record every year. Last year the management pointed proudly to the fact that 3,500 had registered, and that there were 215 exhibitors and 60,000 square feet of floor space. This year, the second convention after the war, in the midst of a period of business dullness, 4,200 registered, 240 firms exhibited and 70,000 square feet of floor space were used. The exhibits were arranged in a fashion very different from that last year. In Philadelphia all the booths were under one roof, but in Columbus they were divided between seven smaller buildings. It was stated by the managers that the main advantage of this arrangement was the segregation of the noisier and more spectacular exhibits from those which call for quiet. This of course gave the quieter buildings an appearance which seemed dull in appearance, but it was evidently the consensus of opinion that the arrangement was satisfactory to most of the exhibitors and visitors.

A VIEW OF BUILDING NO. 2

MEETING OF OCTOBER 5.

On Tuesday, October 5, at 2 p. m., a technical session was held jointly by the Institute of Metals Division and the American Foundrymen's Association. W. H. Bassett presided. The first paper presented was "Investigation of Brass Foundry Fluxes," by C. W. Hill, T. P. Thomas, W. B. Vieg. The paper was read by Mr. Thomas. He was asked, among other things, what happened to the base when the chlorine in salt and the oxides in the metal combined. He answered that it was slagged. H. J. Roast stated that in his experience a borax cover was very satisfactory, and that no occlusion ocurred of the borax in the metal. Mr. F. H. Schutz gave as his opinion that no flux was needed for brass except charcoal and glass, and specially prepared or patented fluxes were absolutely unnecessary; with good melting practice, charcoal and glass were sufficient. Mr. Thomas asked if hydrogen would not go through the glass and attack the metal, but Mr. Schutz answered that this would not occur any more frequently with glass than with any other flux, if the melting furnace was properly handled.

The next paper presented was "Laboratory Testing of Sands, Cores, and Core Binders," by F. L. Wolfe and A. A. Grubb, presented by Mr. Grubb. The paper consisted of an explanation of the methods of making such tests in laboratories. The sands were given a composition test under a microscope for size and shape, a fineness test or screen analysis, a permeability test by means of a water column aspirator apparatus, gas content test, strength test, and other special tests designed for particular products.

J. L. Jones asked whether the sand was dried before mixing with oil. Mr. Grubb replied that it was, and that moreover he recommended dried sand for general foundry practice. F. H. Schutz confirmed this statement from his own experience. A communication was read from Prof. A. C. Lane, of Cambridge, Mass., in which he confirmed the conclusion reached by the authors of this paper.

The question was asked whether the difference in locality from which the sand was produced had any effect upon the amount of oil necessary. Mr. Grubb answered that there was a difference, and that he had noticed that the sharper sands required more oil than the others. Mr. Schutz gave as his opinion that it was clay on the surface of the sand which absorbed the oil, and that if this clay were removed such differences might not occur. It was answered, however, that one of the cases in point was a crushed sandstone which had no clay in it and still absorbed a large amount of oil. Mr. Grubb offered as an explanation of this fact that sandstone contains a certain amount of partially decaying stone, which would naturally absorb more oil. G. H. Clamer offered the suggestion that the oil absorption was due perhaps more to the porosity of the grains than their shape.

The question was asked how the strength tests were made. Mr. Grubb in response said that the cores were made in two shapes; one, a briquet like that used for concrete testing, which was broken in a Wadsworth machine. The other was the cylinder shape about 5/8 inch diameter and three inches long, which was tested for permeability.

The next paper, "The Reclamation of Metal from Brass Foundry Refuse," by F. L. Wolfe and J. E. Alderson, presented by Mr. Alderson. This paper will be found on page 452 of this issue of THE METAL INDUSTRY.

J. L. Jones in a written discussion pointed out that the important feature of this installation was the fact that so much of the waste material was eliminated at once by screening through a 40-mesh screen. This accounted to a large degree for the low costs per ton. He stated also that the slag losses in a Schwartz furnace, given by the authors as 140 pounds per charge, was high, At the Westinghouse plant it ran about 80 pounds. He stated that the practice indicated by the authors was very good, inasmuch as it kept the metal content of the tailings under one per cent; in most cases the metal content ran well over one per cent. These failings are, of course, discarded, but it might be possible to recover the metal cotent, by leaching in the manner explained by Addicks in Chemical and Metallurgical Engineering for April 1, 1919.

H. J. Roast asked what the recovered metal would be worth. Mr. Alderson stated that it would sell at 4 or 5 cents per pound under market price for new metal.

G. H. Clamer gave some interesting details of the problem, with which he had been confronted at the Ajax Metal Company. They had at the time very elaborate equipment. Their tailing losses, however, were high in oxides, which cannot be recovered by concentration. Installation of an ammonia leaching plant might make it possible to recover both copper and zinc oxides, but the commercial success of such an installation would not be at all certain, because of the high installation cost. The remodelling of their plant which had been figured to cost about $40,000 before the war, would now cost $100,000. The efficiency of a concentrating plant depended entirely upon the money spent on it, and this must, of course, be balanced against the tonnage run. Mr. Clamer stated that he thought the paper excellent, that it was practical, conservative and sound, that the figures seemed correct and the recovery excellent.

Mr. Thum stated that the concentrations of tailings, which ran one per cent copper, would be difficult. Sulphides were comparatively simple; they could be recovered either by gravity concentrators or flotation. The oxides, however, were very difficult. Leaching by sulphuric acid or other agents was sometimes practical, but there must be a large tonnage to make it pay.

The next paper was "A New Process for Making 15 Per Cent Phosphor Copper," by P. E. Demmler, presented by the author. This paper was reprinted in THE METAL INDUSTRY of August, 1920, page 314.

Mr. Clamer asked whether the phosphor copper would remelt properly and hold to its original percentage in phosphorus. The author replied that it was the analysis of the remelted alloy which showed 15 per cent phosphorus, so very little was lost. Charcoal was used and no flaming or trouble was experienced. Probably the original phosphor copper before remelting was not much over 15 per cent.

The question was asked whether a green slime appeared on the alloy. Mr. Demmler said that there was very little, that he had attributed what there was to slag, but was not sure whether it might not indicate excess phosphorus.

Mr. Clamer asked what results had been obtained by remelting phosphor tin. The author stated that he had made phosphor tin up to 13 per cent which was very easily dissolved in molten tin. However, this alloy decomposed on remelting so that the resulting analysis showed only 2 to 3 per cent phosphorus.

Mr. Roast asked whether or not lead and arsenic could be combined in the same way. Mr. Demmler answered that they could.

Mr. Clamer stated that in his experience phosphor tin over three per cent could not be handled in the molten condition.

The next paper was "The Relation of Die-Casting to Foundry Practice," by Charles Pack, in which Mr. Pack stated that although great progress had been made in die-casting, he believed that the development in the art of metal casting had not kept pace with the rapid strides made in other branches of manufacturing. Die-casting now covers the field of lead, tin and zinc base alloys, and during the last five years had been extended to aluminum. Further than that, however, it had so far been impossible to go. The author gave a list of five requisites for satisfactory permanent molds for casting brass and bronze, which were as follows:

1. Heat resistance. The material must not scale or oxidize at the temperatures of 1600 to 1800 Fahr.

2. Expansion. The material must have a very low coefficient of expansion.

3. Elastic limit. The material must have a high elastic limit.

4. Conductivity. Low conductivity is necessary to enable the metal to fill the cavities of the mold without the use of high pressure.

5. Strength. The material must have an extraordinarily high tensile strength, if small cores are to be cast.

The writer gave as his opinion that the material meeting the requirements outlined was not available at the present time. In the absence of such material, the brass die-casting process must be classified with the foundryman's "permanent mold," as merely a dream without prospects of realization.

Mr. Roast asked if die-casting had ever reached success in making articles at 1700 deg., Fahr., of soft metal. Mr. Pack answered that it had not, at least so far. It had been impossible to find a steel for the mold; that it was difficult even to cast aluminum at 1200 degrees.

C. J. Zaiser stated that his company, the American Metal Products Company, of Milwaukee, had succeeded in die-casting chisels of the composition copper 84, aluminum 12, and iron 12, with a scleroscope hardness of 44. To this Mr. Pack replied that he could very easily understand that they had succeeded in casting such an alloy or, for that matter, any bronze or brass alloy. The difficulty was not casting one or a hundred articles, but in casting enough to make the process pay for the cost of the die, which never lasted, either because of breaking by the shrinkage of the casting or because of a checked surface. Many firms had started in the business of brass and bronze die-casting, but had failed.

The next paper was "The Solubility of Hydrogen in Molten Copper and Copper Alloys," by C. W. Hill, T. P. Thomas and G. P. Luckey, presented by Mr. Thomas. In the discussion the question was asked whether it was certain that hydrogen was obtained in a test of the gases evolved from brass. Mr. Thomas stated that the gas had been passed over copper oxide and through a tower of P_2O_5, in order to test it. The increase in these substances was accounted for as hydrogen.

J. L. Jones stated that he had noticed the first heat in an open flame furnace contained more dissolved gases than the later heats. The metal was always more viscous and sluggish. The later heats were always better because of the more complete combustion.

P. D. Merica asked whether CO was found in the metal, and the author answered that after the paper was written it had been found that CO and CO_2 followed the H curve in solubility.

D. R. Kellogg stated that it was the composition of the flame which determined whether or not the oxidation would be good or bad.

W. H. Bassett, who was presiding at this meeting, asked about the effect of SO_2. The answer was that it produced cuprous oxide and cuprous sulphide, and that the metal on cooling gave off SO_2, just before solidification. Mr. Bassett stated that he had obtained SO_2 by melting brass in a vacuum furnace.

The next paper was "Carborundum Refractories in Non-ferrous Metallurgy," by Dr. M. L. Hartman. The author stated that refractories of silicon carbide were made in recrystallized shapes, bonded shapes, cements and fire sand. He enumerated the properties of the first two of these products, and outlined the uses of all four in general furnace practice. After discussing the use of various bonding materials, he explained how carborundum refractories were applied to problems in crucible, tilting or rotary or reverberatory furnaces. The records of certain refractories in furnaces where extraordinary conditions prevailed were given, and in conclusion the author stated that the uninterrupted operation made possible by the refractories described, compensated for their high first cost.

J. L. Jones asked how the recrystallized carborundum fails in a roof; whether by hair cracks or oxidation. Dr. Hartman said that there was no oxidation. Mr. Jones asked whether there was danger of too many hair cracks through excessive brittleness, to which the answer was that there was some danger, but not so much as with fire clay.

P. D. Merica asked about the resistance of carborundum to soda and lime vapors. The answer was that carborundum would not stand up long in contact with alkalis.

Mr. Davidson asked whether the author would recommend the use of carborundum lining in electric furnaces, such as the Detroit furnace. Dr. Hartman answered that it had done good work in this furnace. He stated that it would be attacked by lead, but very little by salt.

MEETING OF OCTOBER 6

On Wednesday, October 6, at 9:30 A. M., the second session was held jointly by the Institute of Metals Division and the American Foundrymen's Association. G. H. Clamer presided.

The first paper presented was on "Casting Losses in the Aluminum Foundry," by Robert J. Anderson. This paper was a brief abstract of a bulletin soon to be published by the Bureau of Mines, and covering an extensive investigation of casting losses in the aluminum foundries of the United States.

The author himself read the paper on the causes of casting losses and listed a number of contributing factors under the headings: Metallurgical factors, molding factors and miscellaneous factors. He next described the conditions found at representative aluminum foundries touching upon the relation of casting losses to the kind of castings made, a composition of the melting charge, the melting ratio and the rate of production. The author discussed some of the difficulties encountered in making castings, including core troubles, melting problems, etc. The subjects of inspection, salvage specifications, welding and soldering to reclaim castings were considered. In conclusion, the author stated that the total monetary loss involved in defective aluminum castings was $1,125,000, of which $600,000 could be saved by eliminating the occurrence of avoidable defects.

In the discussion, Mr. Pannell, after expressing his approval of the paper, asked if anything had been done to eliminate loss by means of new mixtures. Were the new alloys any better than the old? Mr. Anderson replied that it had always been accepted as a fact that the old castings with 33 per cent zinc cracked more often than the No. 12 castings which contained 8 per

cent of copper. At the present time, 97 per cent of all of the aluminum castings made in this country contain from 5 to 12 per cent copper, 90 per cent of the castings are of the regular No. 12 alloy with 92 aluminum and 8 copper. It might be possible that there were other alloys cheaper and better. He believed that eventually the No. 12 would be dropped to a great extent.

P. D. Merica asked about the origin of cracks. Mr. Anderson replied that the Bureau of Mines was taking up an investigation of the cause of the cracks, blowholes, etc., which would be published later. However, cracking caused only 2 to 2½ per cent of the loss.

Another question was about materials used for chills. Mr. Anderson replied that he had no definite data on this subject. Cast iron, steel and even aluminum was used. Dr. Merica asked if it was true that the British No. 5 alloy with 11 per cent zinc and 3 per cent copper cracked more readily than the American No. 12. Mr. Anderson stated that the general impression was that this was the case. He had, however, no reliable information. So far as his own experience went, there was not much difference. Mr. Clamer, who was presiding at this meeting, told of a striking example of the inconvenience of a cracked casting. A perfectly good day's fishing had been spoiled for him by the appearance of cracks in the engine of his motor boat.

Mr. Breed told of an interesting case of a growth in a casting, which after a year or more had developed a large number of bumps and hollows. The casting was used for electrical meters. They tried by all possible methods to remedy the difficulties, but finally had to drop the use of the mixture which they had, and to substitute one with 9½ per cent copper and no zinc. Mr. Breed had also seen the same trouble occur in die-castings.

The next paper was on "Pouring Temperatures as Affecting Casting, Shrinkage and Solidities," by R. R. Clarke. Mr. Clarke, who presented the paper, stated in introducing the subject that his paper dealt with the pouring of various castings in which the bulk was heavy or variable, or the relation of volume to surface high. He outlined the problem by stating four fundamentals to the effect that shrinkage decreases as temperature rises; clean lines and compactness rise with temperature, a closely defined and dangerous limit intercepts a rising temperature, marking the activity of the gases and oxides and making for a most distressing condition in the castings; hot pouring necessitates molding with that end in view.

The paper was devoted to a brief discussion of these points. Mr. Clarke stated that with respect to the high lead mixtures or the 88-10-2 or the 88-7-5 mixtures, a crackling and spattering or a curdled milk appearance indicated too high a temperature. However, castings at too low a temperature caused excessive shrinkage and unclean metal.

Mr. Clamer expressed his appreciation of the paper, saying also that Mr. Clarke seemed to be able to visualize what went on inside the molds.

An example was quoted of unsoundness in casting cylinders. These cylinders on cooling developed annular cracks, which went in some cases through the entire cylinder. Mr. Patch claimed that the best way to eliminate such cracks was by carefully melting. He stated that he had the same difficulties in the same sort of castings, namely bushings. The cleavage line was due to the separation of crystals by the film of oxide. It was necessary to be particularly careful in castings of this sort because of the large amount of surface exposed to the mold. He had cast two test pieces; one the bushing showing the cleavage line which had been discussed, and the other a bar showing no oxide to the naked eye. Under the microscope, however, the oxide on the surface of the bar was visible. In the bushing it could not be seen because of the fact that there were two surfaces presented to the mould. Mr. Clamer was asked if he was sure that the oxide was there before the cracking and not after the cracking had occurred, by contact with the air. Mr. Patch answered that he had made a number of experiments to determine this, and that he was sure the difficulty could be avoided by proper melting.

Mr. Anderson suggested that it was very dangerous

A TYPICAL BOOTH

to attribute the trouble to any one thing. The furnace atmosphere was most important. Nevertheless, the terms oxidizing, reducing and neutral were not certain; in fact, not very thoroughly understood, and it was not at all sure that the atmospheres were what they were generally supposed to be.

Mr. Patch was asked what was the upper danger point of such temperatures. He answered that it was variable for different mixtures. For instance, a mixture with 89 copper, 11 tin and ¼ phosphorus should be poured at 1960 degrees, so that the last mold would be poured not under 1920 degrees. This could be regulated by taking little enough metal in one ladle. Moreover, in an alloy of this type, the temperature could be read by means ot a pyrometer. However, in zinc alloys it was more difficult because the zinc flare spoiled the possibilities of taking a true temperature reading. The same difficulty was true with manganese bronze. In his experience he had found it best to trust to the eye of trained casters for temperature judgments on such zinc mixtures.

Mr. Clamer asked Mr. Clarke how he overcame the difficulty of phosphor bronze burning into the mold at high temperature. Mr. Clarke answered by stating at the very start that he could not overcome it completely. However, for a heavy casting, he used half new and half old sand, dried, sieved on the floor and not near the pattern, rammed his mold very hard, faced with plumbago, and dried.

Mr. Clamer in conclusion of the discussion stated that he agreed thoroughly with Mr. Clarke in his contentions. Seventy-five per cent of the casting difficulties that had come to his attention were due to cold metal.

The next paper was "An Improved Electric Brass Melting Furnace," by C. H. Booth, which will be found on page 456 of this issue of THE METAL INDUSTRY. In the discussion of this paper, which was presented by Mr. Booth, Mr. St. John, after stating that he did not desire to go into the good and bad points of different furnaces at this meeting, as it would be out of place for electric furnace manufacturers to carry on such a discussion, said that in the Detroit furnace, working on high lead mixtures, they had found only ¼ per cent variation in the lead content between the first and the last ingot, so he did not believe that a fluted lining was necessary to effect a complete mixture. He had also found that the Detroit sectional linings lasted from 700 to 1000 heats. He agreed with Mr. Booth that the single-phase current was better than polyphase for the foundry, and that it was better to charge the furnace before leaving it for the night.

Mr. Bragg stated that in the Michigan Smelting & Refining Company's plant they had three types of furnaces operating for the fifth year. Ninety per cent of their output was melting electrically. Their operation was 24 hours. He was decidedly in favor of electric furnaces, but it was difficult for him to speak authoritatively because of the difference in power situations, type of work done, etc. He believed that eventually almost all metal would be melted electrically. So far as he had been able to see, the Booth furnace looked satisfactory, but he was not ready to speak with certainty at that time. He believed that it was up to all manufacturers to take something of a chance on electric furnaces. No one could depend on another's advice. More experiments would help to develop the brass industry, and this could not be done by concentrating the experimental work in one company.

Mr. Clamer asked what was the relative cost between electric furnace melting and pit fire melting. Mr. Bragg answered that under the conditions at his plant, with the cost of electricity at .8c. per k.w.h., during 1919 the cost was a little under half the cost of melting by coke with No. 250 pots. These figures covered a production of about 80,000,000 pounds per year.

Mr. Busch stated that in his plant, the Booth furnace had been giving great satisfaction, was very much better so far as the metal quality was concerned than gas, and that it made it very much easier for them to consume their own borings and skimmings.

The next paper was on "Coke and By-Products as Fuels for Brass-Melting," by F. W. Sperr, Jr. Mr. Sperr was not present, so his paper was read by Dr. Merica. Two other papers were scheduled for this session, namely, "Status of the Electric Furnace in Non-Ferrous Industry," by E. F. Cone, and "Producing Small Non-Ferrous Castings," by Raymond H. Sullivan. Neither of these gentlemen was present, however, so the papers were not delivered.

So many of the papers read were of importance that it is impossible to include them all in this issue of THE METAL INDUSTRY. We shall, however, print in subsequent issues reprints, either in full or in abstract, of all the papers of interest presented at the convention.

MEETING OF OCTOBER 7.

On Thursday, October 7, a session of the Metals Division was held on general, and metallographic topics, at which the following papers were presented:

"Charpy Impact Test as Applied to Aluminum Alloys," by E. H. Dix, an abstract of which was published in the September issue of THE METAL INDUSTRY, page 421.

"Colloidal Study With Metals and Alloys," by J. Alexander.

"Transition Phenomena in Amalgams," by A. W. Gray.

"Physical Test on Sheet Nickel Silver," by W. B. Price and P. Davidson.

"Nickel-Chromium Alloys," by Leon O. Hart.

ENTERTAINMENTS AND OTHER FEATURES

On Thursday, October 7, at 9 p. m., a smoker of the American Foundrymen's Association and the Institute of Metals Division, which included several entertainment features, was held. This meeting also included a business session. The address by the president, C. S. Koch, of McKeesport, Pa.; report of the Board of Directors, by C. E. Hoyt, secretary, and the report of the secretary-treasurer, by C. E. Hoyt. On Wednesday night the annual banquet was held at the Deshler Hotel, with several most entertaining entertainers. Dancing followed the banquet.

On Wednesday and Thursday, plants were visited, among which were Atlas Brass Foundry Company, Jeffrey Manufacturing Company and American Rolling Mill Company. A blind par golf contest was held and several prizes awarded for the week. An extensive entertainment program was laid out for the ladies.

At the smoker, the new officers were announced, among whom were W. R. Bean, Eastern Malleable Iron Company, Naugatuck, Conn., president, and C. R. Messinger, Singer Steel Casting Company, Milwaukee, Wis., vice-president. C. E. Hoyt, Chicago, was reappointed secretary-treasurer.

Officers of the Institute of Metals Division will not be elected until February. However, two men interested in metals, aside from iron and steel were elected directors of the A. F. A. for one year, namely, G. H. Clamer, Ajax Metal Company, Philadelphia, Pa., and L. W. Mueller, H. Mueller Manufacturing Company, Decatur, Ill.

British Institute of Metals

A Report of the Autumn Meeting in Barrow-in-Furness, England

The Autumn Meeting of the Institute of Metals opened at the Town Hall, Barrow-in-Furness (Eng.) on Wednesday, September 15th. About 100 members were present. The Institute was given a civic welcome by the Mayor, Col. W. F. A. Wadham (a director of the Barrow Hematite Iron Company), who was supported by Sir James McKechnie (Managing Director of Vickers Limited), and other members of the Corporation.

Engineer Vice Admiral Sir George Goodwin K.C.B., LL.D., President of the Institute, acknowledged the welcome, and mentioned that the Institute had its headquarters in London and periodically visited centres of industry in the country. The Institute members had a great interest in both ferrous and non-ferrous metals, and he felt certain that there would be a great deal in Barrow that would be of service and interest to them.

The first paper to be read was that of Mr. H. B. Weeks, F.I.C., of Vickers Limited, entitled: "Notes on Brass Foundry Practice." It was followed by that of Professor H. C. H. Carpenter on "Crystal Growth and Recrystallization in Metals."

Criticising the latter paper, Dr. W. Rosenhain, F.R.S. (Head of the National Physical Laboratory), described it as destructive, questioning existing theories without attempting to put anything in their place. Dr. Desch (Sheffield University) said he regarded the paper as an extremely useful contribution to the subject and did not think it could be considered as purely destructive. It undoubtedly marked an advance in the study of recrystallization of metals. Dr. Hatfield (Sheffield) and other speakers also congratulated the author on his valuable work.

The paper by Mr. T. G. Bamford (Birmingham) and Mr. W. E. Valland (Birmingham) on "The Influence of Gases on High Grade Brass" and that of Mr. D. Hanson (Teddington) and Miss Marie L. R. Gayler (Teddington) on "The Constitution of Alloys of Aluminium and Magnesium" were also discussed at this session.

In the afternoon the members were entertained to luncheon at the works of Vickers Limited. Sir James McKechnie presided and in offering the visitors a hearty welcome said that it was appropriate that the Institute of Metals should visit such works as the more those engaged in scientific research came in contact with factories where experimental research was applied commercially the greater would be the concentration of effort towards finding a path that led to efficient production. The Iron & Steel Institute had brought the more common metals to a state at which wonderful precision could be attained commercially. The Institute of Metals in its short career had made even more remarkable progress in the discovery of the properties of non-ferrous metals and alloys. The researches and experiments carried out by Dr. Bengough's Committee on Corrosion were classical for their all-embracing scope, their careful execution, their thoroughness and the practical utility of the results. Individual members had done most beneficial service in private laboratories, in chemical and physical examinations of copper, brasses, bronzes, aluminium and its alloys and all white metals. It would not be invidious to mention specially the work of Professor H. C. H. Carpenter in connection with steel, gun metal, propeller material, and the metallurgy of copper. They were glad also to have with them Professor T. Turner, of Birmingham, and to remember his valuable contributions to the progress of non-ferrous metals. Dr. Rosenhain had been a versatile and efficient investigator. As marine engineers, they were grateful also to Sir John Dowrance for his research on the effect of temperature on the physical qualities of the copper tin and zinc alloys.

"There is" (Sir James McKechnie continued), "I think, a steady increase in the use of non-ferrous metals in shipbuilding machinery. In the old steam reciprocating engines, only about 4 per cent of the metal was non-ferrous, but with double-reduction geared turbines, the percentage has increased to 7 or 8, whilst in cruisers it is 15 per cent. It will probably surprise you to know that internal combustion engines for merchant ships there is only about 3 per cent of non-ferrous metals, but in the largest and fastest submarine boats built here, where there is a combination of oil engines, steam turbines and electrical machinery, the proportion comes out as high as 37 per cent of non-ferrous metal to the total metal used. Probably this suggests that the marine engineer might find possibilities for increasing power with minimum weights by resorting more to such metals, especially for naval machinery. In our works here we have got tensile strengths up to 20 tons with large castings of Admiralty gun-metal, with elongations up to 20 per cent. With high tensils brasses for propellers we have got over 40 tons, with elongations not less than those specified for the lower tensile metals. Without non-ferrous metals, it would have been impossible to produce the right airship. In the airship most recently constructed here, 86 per cent of the metal used was Duralumin, and, of the remainder, 2 per cent was aluminium castings and gun-metal, 12 per cent only was of steel, in the form of tensile wire. Duralumin, with a specific gravity of only 2.8, gives a tensile strength of 25 to 28 tons, with an elongation of 15 per cent."

Sir George Goodwin, replying to the toast of "The Institute of Metals" which had been proposed by Sir James McKechnie, said that he had known the Barrow works of the Vickers Company for 30 years. The variety of work carried out in that establishment was second to none in any part of the kingdom. Speaking of the colossal amount of work turned out at Barrow during the war, Sir George referred especially to the submarine and airship work for which Messrs. Vickers were pioneers in Great Britain. He proposed continued prosperity to the firm of Vickers in Barrow.

The first day was brought to a brilliant conclusion by a conversazione at which the members were the guests of the Mayor and Mayoress in the Town Hall.

On the Thursday morning the paper by Mr. R. T. Rolfe on "The Effect of Increasing Proportions of Antimony and of Arsenic Respectively from the Properties of Admiralty Gun Metal" was given.

The President (Sir George Goodwin) said that it was certainly a disagreeable thing to find that there had been some defects in Admiralty gun metal. "As a simple sailor," added Sir George, "I ask for copper, and I expect to get it without impurity." Mr. F. Johnson (Birmingham) agreed that the beneficial influence of remelting alloys was important, but he was inclined to doubt whether the results would be beneficial in regard to gun metal. Mr. A. R. Taylor said that the results achieved by Mr. Rolfe would have been particularly important during the war period. On one occasion a quantity of gun metal went wrong. It might have been arsenic, or it might have been antimony, but during the war there was no time for investigation. Mr. Rolfe's paper gave

them a clearer insight into those little troubles. Mr. Rolfe, in his reply, said that he was not prepared to admit that arsenic had a beneficial effect, although he admitted that it had not so prejudical an effect as antimony.

The next paper discussed was that of Engineer Lieutenant Commander G. B. Allen on "Service Experience With Condensers." Professor Carpenter, chairman of the Corrosion Research Committee, remarked that there was no one cure for corrosion, but every single case had to be met and dealt with on its merits. After some remarks by Dr. Bengough and others, the president said that the paper was put forward as a statement of fact on points which the members of the Institute and of the Corrosion Research Committee might like to think over. It also brought home the fact that corrosion was not the only trouble with condensers.

The papers by Mr. F. Johnson (Birmingham) on "Some Features in the Behavoir of Beta Brass When Cold Rolled," and by Mr. J. H. S. Dickenson (Sheffield) on "A Failure of Manganese Bronze," were also given, but the papers by Dr. O. F. Hudson and J. H. Darley (No. 8), and that by Miss Kathleen E. Bingham (No. 4) were omitted because of lack of enough time.

A luncheon was given on Thursday afternoon at the Furness Abbey Hotel by the Barrow Hematite Steel Company. Mr. G. Mure Ritchie, chairman of the company, proposed the toast of "The Institute of Metals." He said that the institute had been founded twelve years ago, and for an organization of the kind had made remarkable progress. Its membership was 1,350 and, as most of them knew, it had been run on lines analagous to those of the world-famed Iron and Steel Institute. The Institute of Metals was performing an exceedingly useful function. The membership was open to ladies, and they had contributed a considerable share to the discussions at various meetings.

Sir George Goodwin, in his reply, said that the work carried out by the Barrow Hematite Steel Company in that district was of great importance. The company employed in different ways 5,000 men, and their's was one of the oldest industries in Barrow.

The visitors spent the remainder of their stay some in visiting the works of the Barrow Hematite Steel Company, and other well-known firms, and others in a steamboat trip in England's famous Lake District.

Aluminum Casting

Q.—We are sending you via Parcel Post, an aluminum "Base" casting, and, wish that you would note the following:

We are using a regular aluminum molding sand and the castings are made on a molding machine. The face of this casting is made in the drag, construction of this casting making it impossible to cast otherwise.

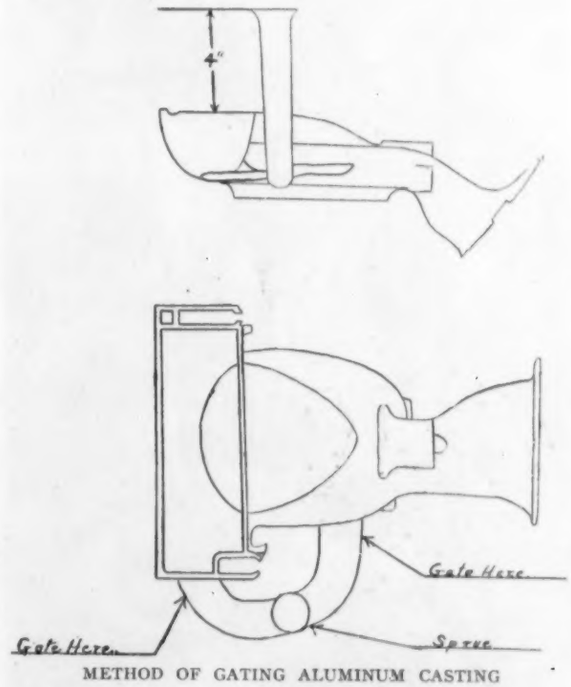
A regular No. 12 aluminum is being used and poured at a temperature of 1375 to 1425. Metal is melted in an iron pot and poured with a small hand ladle. A flux of Sal Ammoniac is used to clean the metal.

Can this pitting be caused by hard cores, or a foreign substance in the metal, or is heavy suction in front the cause?

A.—Inspection of this casting shows the defect to be what is called minute holes and sand holes. We believe these holes to be caused by oxidized metal and core sweat. To eliminate the core sweat use just enough oil in your mixture so that the core will not draw moisture, and to prevent wash when the metal is poured.

Aluminum oxidizes every time it is melted, even under the best conditions. Therefore reclaimed aluminum will contain more alumina than new metal which does not rise to the surface of the metal. This is what causes these holes, as the alumina rises to the surface of the casting generally in the thin section. You will find out of the same ladle of metal some castings that are perfect and others with defects similar to your sample casting. If you are using reclaimed No. 12 alloy, stir the metal well with a nichrome stirring rod before taking from the furnace. Nichrome is not essential, but will last much longer. Also the temperature of the aluminum when poured has an important bearing on the problem, but 1400° Fahrenheit is not too high. Never let the metal get over 1600° Fahrenheit in the furnace. I often think foundries would be money ahead if when they overheat a pot of metal they would pour it out in ingots and use a small amount to each charge or dig a hole and bury it.

I would suggest that you change the gate to extend to the end, similar to the sketch, and this will enable you to lower the pouring temperature to 1250° Fahrenheit. Also raise your pouring sprue 4" above the top of the casting so as to get the pressure. The more rapidly the



METHOD OF GATING ALUMINUM CASTING

metal sets after it gets in the mold the better it will be for the casting.

Hard ramming and too wet sand will also cause these defects. A sand that will bond with a minimum of moisture should be selected. If the aluminum comes in contact with a hard rammed surface or too moist surface, the metal trembles and will cause these holes.

If an alloy of 8 per cent. copper and 92 per cent. aluminum is used, and precautions are taken not to overheat (as iron pots are hard to regulate properly) and the metal is poured at a temperature not over 1400° Fahr., 1250° preferred, there is no reason why satisfactory castings should not be produced. Your core, however, is rough for this class of work.—W. J. R.

Core Baking in Electrically Heated Ovens

A Description of a New Electric Core Oven Developed by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Read at the Columbus Meeting of the American Foundrymen's Association, October 8, 1920.

By JESSE L. JONES, Metallurgical Editor, The Metal Industry

SUMMARY

A new type of electric, automatic, regulating thermostat is described. The results of tests made in an electrically heated core oven are given. The advantages of the electric core oven are enumerated.

The core department of most foundries has received too little attention in the past. This is especially true of the ovens used for baking the cores. The average oven that is fired by gas, oil, coal or coke has neither insulation nor temperature control. Hence, it is wasteful of fuel and considerable losses are incurred from overbaked or underbaked cores and from inability to speed up production without endangering the quality of the product.

FIG. 1. VIEW OF CORE OVEN SHOWING SHELF

While it is not the purpose of this paper to discuss in detail either the various methods of electrically heated core ovens or of automatically controlling them, it will be of interest to give a brief description of a new thermostat that is very reliable and comparatively inexpensive. The control element consists of a strip of porous refractory material impregnated with a material that is non-conducting up to a given temperature and conducting above that temperature. The porous strip is supported by silver terminals and connected with a suitable relay, motor-driven switch and small transformer, the last named three pieces of apparatus being assembled in one self-contained unit. The impregnating materials will not only regulate at the temperature required for core oven work, but are capable of controlling any temperature from 150° F. to 1450° F., with possibilities above and below these points. A portable outfit having a two-point control and indicating signal lights is exhibited.

The following tests were made to determine what would be satisfactory baking conditions for the electric core oven and to ascertain some of the advantages of this oven over fuel heated ovens. It was not intended to deal specifically with any particular type of oven but to investigate some of the advantages of electric heat in an oven where ventilation is carefully regulated, the temperature accurately controlled and the heaters so placed as to give a uniform temperature in all parts of the town.

The oven used was of a draw shelf, commercial type. It was 5 ft. 8 in. wide, 6 ft. 8 in. deep and 7 ft. 6 in. high, of sheet steel construction, with walls about 4 in. thick, fairly well insulated except on the bottom where the concrete floor allowed the escape of considerable heat. The oven was equipped with a fan driven by a variable speed motor and so arranged that the air could be exhausted of recirculated or a portion could be exhausted and the rest recirculated. Accurate thermostatic control was provided.

Figure 1 shows a view of the oven while Figure 2 gives a chart of a representative day's run.

Three core mixtures were experimented with, as follows:

	NO. 3 MOLDING MACHINE WORK	NO. 4 HEAVY BENCH WORK	NO. 7 SPLICER CORES ONLY
Silica Sand	63.95%	16.03	97.30
Molding Sand	21.35	....	....
Sand Blast Dust	11.88	19.60	....
Old Core Sand	....	64.14	....
Oil	1.78	....	2.03
Dextrin	1.04	.23	.67

As it was desired to ascertain the conditions under which cores of the very best quality could be produced, a number of runs were made on each of the above mixtures, varying the temperature and time of baking. Test cores of two kinds were used to judge of the thoroughness of the baking; tensile, using the regulation brass molds designed for making specimens for cement testing and compression, using a 2-in. cube. A compression and a tensile test piece was placed on the top, middle and bottom shelf with each lot of cores.

Prior to making the tests, a number of runs were made to determine what would be a satisfactory ventilation of the oven. It was run at a constant temperature of 400° F., and loaded with weighed charges of production cores, test pieces being placed on the top, middle and bottom shelves. The rate of change of the air in the oven was controlled by the dampers and the speed of the motor, the air pressure being registered with pitot tubes. The changes of air were obtained by calculation from the volume of the oven, pressure and temperature of the air exhausted and recirculated. Recirculating the air 30 times per hour was the rate decided upon and used in the tests made.

The average results on the three core mixtures were as follows:

NO. 3 CORE MIXTURE

Run No.	Temp., Deg. F. Initial	Final	Time, Hours	Crushing Load, Lbs.	Tensile Strength, Lbs.	Per Cent Moisture in Core Sand	Baked Cores	Power, K.w.h.
1	300	300	3	253	21	5.74	.18	40
2	300	350	2½	500	50	26.70	.12	30
3	300	400	1½	1,712	192	5.44	.13	30
4	300	450	1½	1,739	187	5.44	.13	40
5	300	500	1½	1,244	166	5.44	.12	50
8	450	450	¾	1,965	121	5.44	.16	20
9	500	500	1	1,516	142	5.44	.11	20
				NO. 4 CORE MIXTURE				
10	450	450	1	1,171	87	6.38	.18	20
13	350	350	1½	776	46	6.38	...	20
14	450	450	1¼	1,550	142	6.38	.14	30
15	300	300	1½	675	66	6.47	.13	20
16	350	350	2	802	95	6.47	.16	40
17	400	400	1	906	88	6.47	.14	20
18	400	400	1½	1,206	105	6.47	.16	20
				NO. 7 CORE MIXTURE				
19	300	300	1	815	97	....	...	20
26	400	400	1	1,856	182	....	...	30
27	400	400	1½	2,209	194	....	...	40
28	400	400	2	3,854	342	....	...	50
29	350	350	1	754	66	6.13	...	20
30	350	350	1½	1,313	118	6.13	...	30
31	350	350	2	2,690	180	6.13	...	50

COMPARATIVE TESTS IN A CONTINUOUS OVERHEAD GAS HEATED OVEN

NO. 3 CORE MIXTURE

Run No.	Temp., Deg. F. Initial	Final	Time, Hours	Crushing Load, Lbs.	Tensile Strength, Lbs.	Per Cent Moisture in Core Sand	Baked Cores	Power, K.w.h.
6	...	...	2	467	62	5.44	.12	..
				NO. 4 CORE MIXTURE				
11	...	...	2	776	65	6.38	.14	..
				NO. 7 CORE MIXTURE				
32	...	...	2	677	87	6.17	...	..

COMPARATIVE TESTS IN AN OVEN FIRED WITH GAS AND OIL

NO. 3 CORE MIXTURE

7	...	...	(25 min.)	832	140	5.44	.16	..
..	...	...	2½	1,519	102	....	...	..
				NO. 4 CORE MIXTURE				
12	...	...	1	833	57	6.38	.09	..
..	...	...	2	779	78	6.38	.16	..
				NO. 7 CORE MIXTURE				
34	...	...	3	1,167	110	6.17	...	..
..	...	...	3	1,334	101	6.17	...	..

The results obtained on the comparative tests made show that the electrically heated oven produces cores having from 50 to 200 per cent more strength than the fuel fired ovens.

In baking large cores containing oil, it is customary to heat at a low temperature at first to allow the moisture to escape before the oil hardens. The first tests on No. 3 Core Mixture showed, however, that this is unnecessary on small cores.

The excessive moisture (26.70 per cent) which was found on Run No. 2 for the core sand, did not crack the cores or injure them in any way. It is undesirable, however, as energy is wasted in expelling it.

CORE BAKING IN ELECTRICALLY HEATED OVENS

An inspection of the results obtained indicates that baking at 450° F. for somewhat less than one hour, gives the best results. The dextrine binder seems to be weakened by prolonged baking above 400° F. At 400° F., however, overbaking 50 per cent or more does little harm. One lot of oil cores baked over night by neglect to turn off the current, were found to be of good quality.

When forcing an oven at a high temperature, an alarm clock is useful to indicate when the cores should be removed to prevent overbaking and waste of heat.

It was found that the weight of the cast iron core plates was almost equal to the weight of the cores. It is desirable to reduce the weight of the core plates to the minimum consistent with stiffness. However, the current loss due to heating these plates is only about 20 per cent of the radiation loss of the oven.

The oil used in the test was a compounded oil containing mineral oil. Stronger cores would have been obtained with pure linseed oil.

Where core ovens are fired with gas, oil, coal or coke, large volumes of carbon dioxide gas are produced even where combustion is perfect. This gas while not poisonous in itself, vitiates the air of the core room, making it an unhealthful place in which to work.

The following conclusions can be drawn from the test of this electrically heated core oven:

1. UNIFORMITY OF TEMPERATURE.—A practically uniform temperature can be obtained in all parts of the oven.

2. CONTROL.—The temperature can be held to within 5° F. plus or minus of any desired temperature.

3. COMPARATIVE FREEDOM FROM GASES.—The only gases given off by the electric core oven come from the core compounds used. These gases are not excessive in amount or dangerous in character.

4. CONDITIONS OF BAKING.—Small oil, dextrine or oil dextrine or oil and dextrine cores can be satisfactorily baked in less than one hour at 450° F.

5. QUALITY.—The cores when baked in the electric oven are from 50 to 200 per cent stronger than when baked in the fuel fired ovens.

6. SPEED.—A greater input of heat unit is possible in the electric core oven without injury to the cores than is possible in fuel fired core ovens.

7. POWER CONSUMED.—While no attempt was made to obtain a very accurate reading of the power consumed in making the tests, it is estimated that about twelve pounds of green cores were baked for each kilowatt hour.

ACKNOWLEDGMENTS

Mr. J. R. McClain supervised the tests described in the above paper and Mr. P. E. Demmler designed the demonstration outfit illustrating the new thermostat, of which he is the inventor. Messrs. O. A. Colby and M. R. Armstrong attended to the engineering details of the oven installation.

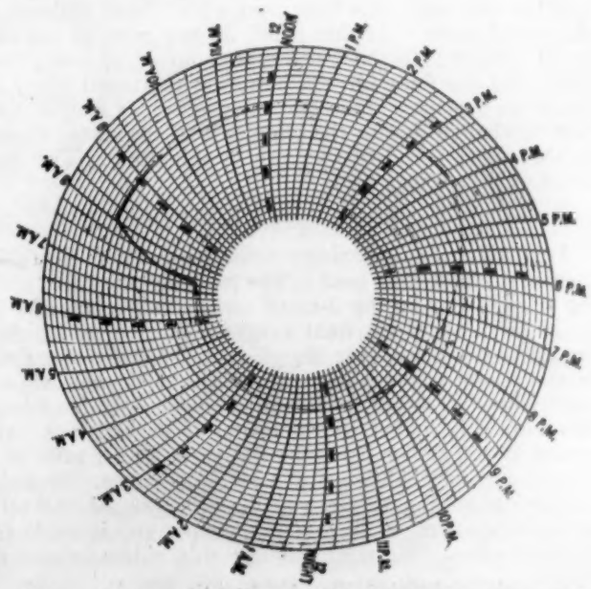


FIG. 2. CHART OF TEMPERATURE MAINTAINED IN OVEN

Reclamation of Metal from Brass-Foundry Refuse

A paper read at the Columbus Meeting of the Institute of Metals Division, Oct. 5, 1920

By F. L. WOLF* and G. E. ALDERSON†, Mansfield, Ohio

The reclaiming of metallics from slag and sweepings is of vital interest to every brass-foundry man, but the first cost and interest on the investment often make it prohibitive for the small foundry to enjoy the benefits of a complete concentrating unit. However, the cost of such an installation and the cost of operation are often exaggerated to such an extent that foundries dispose of their copper-bearing refuse at a great loss. This paper gives the actual costs and the returns obtained in the reclaiming plant used at the Ohio Brass Co. This plant is divided into two sections, the preliminary treatment and concentrating departments. In the former occur the screening, crushing, and hand-picking operations whereby most of the non-valuable and heavy metallic constituents are removed. The concentrating equipment consists of an elevator, bins, jigs, ball-mill, and table.

PRELIMINARY TREATMENT

The preliminary treatment varies, depending on whether the material is slag, foundry-floor sweepings, or brass casting-floor sweepings. Material of the first class is produced from the operation of six Steele-Harvey and six Schwartz furnaces; the second class represents sweepings from an average of thirty-five molding floors per day; and the last is collected around the sprue cutters and knockout bench.

TREATMENT OF SLAG.

The slag, analyzing 30 to 40 per cent. copper, is passed over a 3-mesh yard screen (Tyler standard mesh) stretched on an inclined rectangular frame supported by adjustable legs and equipped with a hopper which directs the undersize into a barrow. The fine product, running about 20 per cent. copper and representing 20 to 25 per cent. of the total slag, goes direct to a storage bin for concentrator feed. The oversize is charged into a No. 2 Hill cinder crusher, which takes 175 to 200 lb. to a charge and crushes two charges per hour through a No. 4 riddle. It requires 6 hp. and operates at 36 r.p.m. The undersize from the riddle goes to the storage bin and the oversize, after treatment with a hand magnet, to the metal room. At this point, 30 per cent. of the material charged to the crusher is removed as heavy metallic and the fines for concentration treatment carry 20 per cent. copper. These percentages are, of course, subject to change due to the character of the metal charge to the furnace and to the care in skimming. The flow sheet is shown in Fig. 1.

TREATMENT FOR FOUNDRY-FLOOR SWEEPINGS.

Foundry-floor sweepings consist of heavy metallic, spillings, cores, and sand. The material for hand picking is removed by the 3-mesh screen and represents 20 to 25 per cent. of the total weight. This is hand picked on a 3-mesh riddle for metallic, nails, and waste; the metal recovered is about 5 per cent. of the original sweepings. A small amount of undersize obtained from this riddle is added to the material passing the yard screen. The undersize from the yard screen goes to a Combs gyratory riddle using a 40-mesh screen. Material remaining on the riddle, say 12 per cent. of the total sweepings, averages 30 per cent. copper and is ready for concentration. Material passing this riddle, about 65 per cent. of the total sweepings at 0.30 per cent. copper, goes to the tailings dump. The flow sheet is shown in Fig. 1.

TREATMENT FOR BRASS CASTINGS-FLOOR SWEEPINGS.

Brass castings-floor sweepings contain heavy metallic, light metallic, nails, wires, broken cores, and core sand. This is kept separate from sweepings taken around the grinders, of which the quantity is so small that the treatment will not be discussed. The procedure is quite similar to that in use for sweepings from the foundry. The 3-mesh yard screen removes 20 to 25 per cent. for hand picking and the recovery of metal is the same as from foundry sweepings. A small percentage of nails is also reclaimed. Undersize from this yard screen goes to screen of similar construction, but with a heavy 10-mesh screen, set at an angle of 45°. The coarse material from this, 10 to 15 per cent. of the total sweepings and approximating 5 per cent. copper, is taken to the concentrator bin. The fines, about 65 per cent. of the total sweepings, analyze less than 1 per cent. copper and go to waste. The flow sheet is shown in Fig. 1.

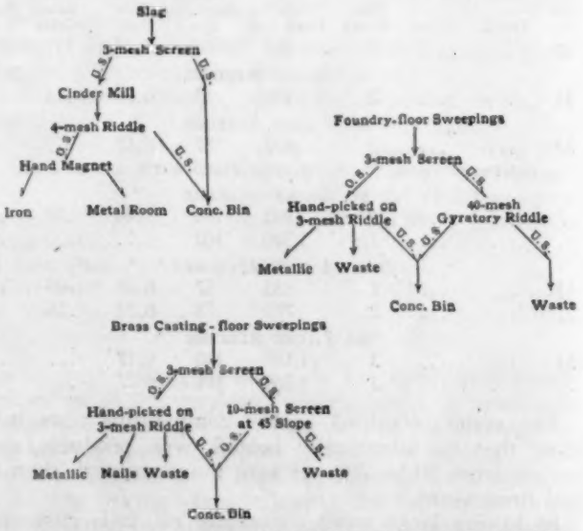


FIG. 1.—FLOW SHEETS FOR PRELIMINARY TREATMENT

CONCENTRATING DEPARTMENT.

In the concentrating department, the feed is charged, by elevator, into a 70 cu. ft. (2 cu. m.) steel feed hopper, the bottom of which is equipped with an automatic feeder that will pass such stray foreign substances as wires, nails, or large pieces of slag. This feeds to a two-compartment Woodbury jig classifier, which operates at 200 r.p.m. and is driven by a 5-hp motor. The first compartment, 12 by 21 in. (30.5 by 53.3 cm.) has a 10-mesh screen and a 1⅜-in. (3.5-cm.) stroke. The second compartment, 18 by 24 in., has a 6-mesh screen and a ¾-in. (1.9-cm.) stroke. The classifier requires from 40 to 50 gal. (151 to 189 l.) of water per minute; 17 gal. go over the tail board to the table and the balance is discharged with the concentrate. Both jigs discharge a fine, or hutch, concentrate, which passes through the screens and downward against the water pulsations. The hutches, after being discharged from the machines, are combined

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†Metallurgical Engineer, The Ohio Brass Co.

and carried by launder to a 40-mesh riddle set over a settling tank. The coarse concentrate, discharged from above the screen on the second compartment, is caught on a 10-mesh riddle set over the same tank. A man stationed at this point changes and cleans the riddles at frequent intervals. By this method, all fines are washed out and a clean high-grade metallic is secured. A small amount of slime rich in metal is recovered from the settling tanks and hand-fed to the Deister table. The water overflowing from this tank is carried to the main sump. The water passing over the tail board goes to the table and then to the sump. The latter serves the double purpose of settling tank and reservoir, a small centrifugal sand pump being used to return the water to the machines.

The metallic recovered in the form of coarse jig concentrates, after drying and passing over a Dings M–2 separator, is taken direct to the metal room for re-use. it is almost pure and represents 60 to 70 per cent. of the total metallic in the feed. The hutch concentrate shows 65 to 70 per cent. copper and carries about 20 per cent. of the metallic in the feed. It is dried and sold.

The tails from the second jig are conducted into a scoop feeder on a 3 ft. by 9 in. Hardinge ball-mill. This feeder carries a heavy 14-mesh screen and all feed passing is by-passed around the mill and joins the discharge. The mill is loaded with 500 lb. of chrome-steel balls, maximum size 2½ in. It operates at 36 r.p.m. and requires about 6 hp. All discharged material is crushed to 60 mesh or finer.

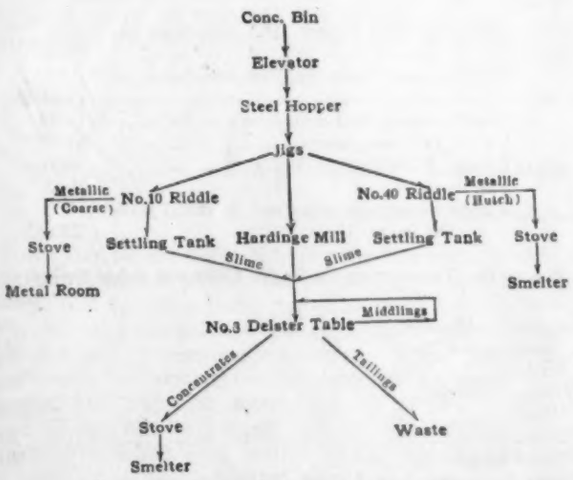

FIG. 2.—FLOW SHEET OF CONCENTRATOR

The fine pulp is conveyed by launder to a No. 3 Deister slime table. The copper content is from 4 to 5 per cent. or say 13 per cent. of the total metallic in the feed. Three products are made: i.e., concentrate, middlings, and tailings. When a regular run is completed, the table is readjusted and the middlings re-fed at the head end. The middlings then produced are classed and thrown out with the tailings. The table, itself, has been re-riffled. The arrangement was retained but the present riffles are double the thickness of the original ones. It is operated at 260 r.p.m. with a ½-in. stroke and requires ½hp. The consistency of the feed is 20 to 25 per cent. solids. The water for the table comes from the jigs and through the Hardinge mill. The amount can be controlled by opening or closing the apertures for hutch and coarse concentrate discharge. The small amount of makeup water required by the system—2 to 3 gal. per minute—is supplied as wash water for concentrate and middlings. These, as well as the tailings, are caught in large tanks, the water overflowing from the concentrate to the middlings to the tailings tanks, thence to the main sump for re-use. When the table is used alone, water is supplied through a by-pass. Concentrate as rich as 65 per cent. copper can be produced, but it has been found advisable to hold it to between 40 and 50 per cent. copper. With a 45 per cent. concentrate, the tailings will carry 0.7 to 0.9 per cent. copper, which is equivalent to a loss of approximately 1 to 2 per cent. of the total metallic fed to the mill. Screen tests have shown that 60 per cent. of this loss is in the form of metallic finer than 150 mesh. The concentrates are dried and sold on the copper content basis.

All drying is done in a sheet-iron oven 30 by 30 by 72 in. (76.2 by 76.2 by 182.8 cm.). This holds twelve trays, each 24 by 30 by 2 in., so set that the heat travels under and over each one. Gas is used for fuel and the burners are two extra heavy 2-in. (5-cm.) perforated pipes. The capacity of this oven is 1500 lb. (680 kg.) of heavy concentrates per charge and 6 to 8 hr. are required to dry this amount.

Quantities and Analyses

		Per Cent. by Weight	Copper Content, Per Cent.
Foundry—floor Sweepings	Recovery: Metallic	6.0	
	Jig feed, 3 to 40 mesh	12.0	20.0 to 30.0
	Jig feed from hand picking	5.5	20.0
	Reject: Cores	11.5	
	Fines through 40 mesh	65.0	0.2–0.7
	Production: 100 lb. per day per molding floor.		
Brass Castings—floor Sweepings	Recovery: Metallic	5.0	
	Jig feed, 3 to 10 mesh at 45°	11.0	5 to 10
	Jig feed from hand picking	9.0	10 to 15.0
	Nails	1.0	
	Reject: Cores	5.0	
	Wire	3.0	
	Fines through 10 mesh at 45°	66.0	0.5–1.0
	Production: 1500 to 1700 lb. per day.		
Foundry Slag	Undersize from 3 mesh	23	20.0
	Undersize from 4 mesh after crushing	54	15.0 to 20.0
	Metallic recovered after crushing	23	75.0 to 85.0
	Production: Steele-Harvey, 50 lb. slag per ton metal melted.		
	Schwartz, 142 lb. slag per ton metal melted.		
Concentrating	Heads		20.0 to 25.0
	Tailings	68	0.7 to 0.9
	Jig hutch	8	60.0 to 70.0
	Jig concentrate	18	70.0 to 80.0
	Table feed		40.0 to 50.0
	Table concentrate	6	40.0 to 50.0

The Dings magnetic separator is used principally for borings and chips from the machine shop; the washings from the jigs constitute a very small percentage of its burden.

ESTIMATED COST OF A COMPLETE RECLAIMING PLANT AND OTHER DATA.

The following costs must be accepted only as approximations on account of the rapidly changing market. Furthermore, erection costs as well as housing, overhead, and upkeep are not mentioned because they would vary greatly in individual plants and locations.

FOR PRELIMINARY TREATMENT		FOR CONCENTRATION	
Gyratory riddle	$150.00	Elevator and bin	$2,00.00
Yard screens (2)	50.00	Woodbury jigs	800.00
Hill cinder crusher	450.00	Hardinge mill	1,200.00
Barrows, riddles, etc	100.00	Deister slime table	500.00
		Pump	300.00
Total	$750.00	Tanks	200.00
		Drying stove	200.00
		Total	$5,200.00
		Total plant	$5,950.00

DATA ON OPERATING LABOR AND POWER

Preliminary Treatment

Screening slag over a 3-mesh yard screen..1 ton per man-hour.
Screening sweepings over yard screens...1 ton per 1½ man-hour.
Riddling sweepings on a 40-mesh gyratory.1 ton per 2½ man-hour.
Hand picking .....1 ton per 15 man-hour.
Cinder-mill labor .....1 ton per 6 man-hour.
Cider-mill power .....1 ton per 27 kw.-hr.

Concentrating

Labor: Elevator .....1 ton per man-hour.
Miscellaneous .....1 ton per 9 man-hour.
Power: Elevator, 3 hp.; jigs, 5 hp.; ball-mill, 6 hp.; table, ½ hp.; pump, 2 hp.; magnetic separator 1 hp.; gyratory riddle, 1/6 hp.

PROPOSED CHANGES.

Several important changes are contemplated in the foregoing equipment. These will be directed toward increasing capacity, decreasing labor and power, and gaining a more uniformly sized feed for jigs and tables. It is proposed to place a ⅜-in. (9.5-mm.) mesh screen on the driving end of the Hill cinder crusher. Inasmuch as the finer material is displaced by the heavier and works to the top, the mill can be charged continuously for 3 or 4 hr., or until the acumulation of heavy-metallic interferes with the operation. The fines will be discharged continuously through the screen and into the elevator boot. Experimental tests have indicated that the capacity of the mill will be doubled and possibly tripled. This is in great contrast to the present method of operation, where the charge must be completely emptied every half hour, hand-riddled, and then hand-fed to the elevator.

The elevator will discharge on to a Dings magnetic pulley, thence on to an impact screen. The sized products from this screen will go to separate bins, one for coarse, or jig, feed, the other for fine, or table, feed. The advantage of this arrangement will be the extraction of all nails, wires, and tramp iron before the feed gets to the concentrating machines and the elimination of fines from the jigs. This will result in an improved grade of fine and coarse concentrate and a decrease in labor and power. A device is also under consideration for dewatering and discharging the jig concentrates into a barrow.

The removal of tailings from the settling tank is extremely laborious work, inasmuch as they are sticky and pack tightly. A scoop conveyor or a dewatering cone with a sand pump have been suggested for this purpose.

A REPRESENTATIVE RUN

The complete records of a representative run are given herewith. All slag, foundry-floor sweepings, and brass castings-floor sweepings produced in a week were segregated and full data recorded on their treatment. In this period, 750 lb. (340 kg.) of slag were produced from the melting of 30,000 lb. of metal in six Steele-Harvey furnaces, and 7916 lb. from the melting of 112,000 lb. of metal were melted in six Schwartz furnaces. These slags, when combined, carried 38 per cent. copper. The subsequent method of treatment has been outlined in the foregoing. There were 21,600 lb. of foundry sweepings, the clean-up from an average of thirty-five moldings floors per day. The brass-castings sweepings, 10,000 lb., were representative of the clean-up after handling small valve and railway castings poured from 71 tons of metal.

PRELIMARY TREATMENT ON SLAG

		Pounds
From melting 56 tons in Schwartz furnaces, slag and skimmings		7916
From melting 15 tons in Steele-Harveys, slag and skimmings		750
Total slag from 71 tons melted		8666
Undersize through 3-inch yard screen		1993
Oversize to cinder mill		6673
Metallic recovered after crushing		1967
Balance through No. 4 riddle		4706
Undersize from yard screen		1993
Feed for concentrator		6699
Costs: Screening in yard, 4.5 man-hours, at 55c	$2.48	
Cinder mill, 20.5 man-hours, 55c	11.27	
Labor, 25.0 man-hours	13.75	
Power, 89 kw.-hr	1.78	
Flat cost	15.53	
Credit on metallic returned to the metal room, 1967 lb. at 17c	334.39	

PRELIMINARY TREATMENT OF FOUNDRY SWEEPINGS

		Pounds
Recovery: Metallic		1,296
Concentrator feed		3,770
Rejects: Cores		2,484
Fines through 40-mesh		14,050
Total weight		21,600
Costs: Screening over 3-mesh, 16.5 man-hour at 55c	$9.07	
Riddling over gyratory, 22.0 man-hours at 55c	12.10	
Hand picking, 36.0 man-hours at 55c	19.80	
Labor, 74.5 man-hours	40.97	
Power, 3 kw.-hr.	0.06	
Flat cost	41.03	
Credit on metallic returned to metal room, 1296 lb. at 17c	220.32	

PRELIMARY TREATMENT ON BRASS CASTINGS-FLOOR SWEEPINGS

		Pounds
Recovery: Metallic		440
Concentrator feed		2,000
Nails		130
Rejects: Cores		410
Wire		400
Fines		6,620
Total weight		10,000
Costs: Screening over 3 mesh, 7.5 man-hours, at 55c	$4.12	
Screening over 10 mesh, 6.0 man-hours, at 55c	3.30	
Hand-picking, 19.5 man-hours at .55c	10.73	
Labor, 33.0 man-hours	18.15	
Power	None	
Flat cost	18.15	
Credit on metallic returned to metal room, 440 lb. at 17c	17.80	

CONCENTRATING TREATMENT

	Pounds	Pounds Copper
Feed: From slag	6,699	
From foundry sweepings	3,770	
From brass castings sweeps	2,000	
Total feed	12,469	
At 23.6 per cent. copper this equals 2943 lb. copper.		
Recovery: Jig hutch (fine), 912 lb. at 65.75 per cent. copper		600
Jig concentrate, 2300 lb. at 85.00 per cent. copper		1,955
Table concentrate, 743 lb. at 42.00 per cent. copper		312
Loss: Tailings from table, 85,414 lb. at 0.90 per cent. copper		76
Accounted for, 12,469 lb. at 23.6 per cent. copper		2,943

	Hours
Running time: Elevator	5
Jigs, ball-mill, and table	8
Ball-mill and table alone	3
Drying stove	24
Magnetic separator	3

Costs: Elevator, 5 man-hours at 55c	$2.75
Feed, 12 man-hours at 55c	6.60
Tailings 11 man-hours at 55c	6.05
Concentrates, 22 man-hours at 55c	12.00
Miscellaneous, 10 man-hours at 55c	5.50
Labor, 60 man-hours	33.00
Power: Elevator	0.24
Jigs	0.60
Ball-mill	1.00
Table	0.16
Pump	0.32
Magnetic separator	0.04
Flat cost	35.36

Credit on coarse jig concentrate returned to metal room, 2,300 lb. at 17c., $391.00.

Credit on fine jig concentrate to market, 912 lb. (600 lb. copper at 18.5c. less 4c. smelting charge, $87.00.

Credit on table concentrate to market, 743 lb. (312 lb. copper at 14.5c., $45.24.

Total return on concentrates, $523.24.

CONCLUSION

The foregoing shows that the returns on a plant of this type are far in excess of the costs, even after such items as overheard, depreciation, interest, rent, upkeep, etc. have been properly charged. This end is attained primarily through the removal of the large burden of low-grade material by cheap screening methods and the consequent decrease in quantity of material to undergo concentration. Furthermore, the operation of such a plant, once installed and properly organized, is extremely simple. Any intelligent man can be taught, in a few days, to supervise the operations and care for the general mechanical adjustments. But a man familiar with concentrating machinery should frequently inspect the machines, supervise the special adjustments, and watch the routine as well as character of the feed and products.

The same equipment could, no doubt, be used to advantage in a foundry of much smaller capacity. But the small foundry that cannot afford a complete installation should give the copper-bearing material the preliminary treatment, to remove the excess of low-grade material and reclaim all heavy copper. The high-grade fines, about 20 per cent. copper, may then be sold to a concentrating or smelting plant. Another plan would be to crush to a fine pulp in the cinder mill all values recovered by preliminary treatment.

Two charges of foundry slag, each of approximately 300 lb., were crushed in the cinder mill for 90 min. and the product screened over 4, 8, and 20-mesh riddles.

On 4 mesh, 77 lb. contained 77 lb. metallic.
On 8 mesh, 42 lb. contained 42 lb. metallic.
On 20 mesh, 48 lb. contained 41 lb. metallic.
Through 20 mesh, 395 lb. contained 89 lb. metallic.
Total, 562 lb. contained 256 lb. metallic.
Metallic in slag, 45.5 per cent.

Practically all slag in a 300-lb. charge can be crushed to pass a 0.050-in. opening at a cost of 50 to 75c. The metallic above this size may be recovered by screening and the product passing the screen may be treated in a series of hydraulic trough classifiers. This method should yield a recovery of 90 to 95 per cent. of the total metallic, as against 98 to 99 per cent. when using a jig and table.

Expensive Castings From Cheap Patterns

Written for The Metal Industry by WILLIAM H. PARRY

Some day before Gabriel blows his fish horn, inventors and their "angels" will awake to the fact that it does not always pay to have their patterns made by the lowest bidder among the jobbing patternmakers, particularly if the work is of a complicated nature. Many people have been prone to look at wood patterns as some things dragged into the shop by the cat, or at best a piece of wood hacked out by an axe, and are only willing to pay accordingly, when as a matter of fact they ought to be the product of highly skilled mechanics. A very recent occurrence will serve to illustrate this point.

An inventor and his backers had decided that they were about ready to grab off some easy money from an unsuspecting public, through the medium of a device which would eliminate the use of coal in all heating furnaces, by the simple substitution of kerosene oil, though they were very careful in their choice of a trade name to camouflage the kerosene, as too common a term, for so complicated a device. After making the rounds of about all the jobbing pattern shops in their vicinity, their choice fell on the very cheapest of them all, regardless of the fact that the design was such that nothing but the highest grade of patternmaking could possibly answer their purpose. The metal thicknesses were 3/16 in. all over, cores within cores, and cores within cores once more, making three separate and distinct walls of metal to be cast of an even thickness. Outwardly the device resembled a small washing machine, and if they had attempted to cast the clothes, water, and soap integral with its outer walls, they would stand about as much chance of getting results as they did to get good castings from such a set of patterns.

I am not blaming the job shop proprietors, as they will make patterns of a grade to suit your pocketbook, though knowing full well that the troubles of the buyer will commence in earnest when the jobbing foundrymen starts on the job of assembling the cores before placing in the mold, and then setting the assembled cores in the mold before "closing down."

At last accounts this band of "cheap skates" had exhausted the patience of all the local foundrymen, and were seeking pastures new and green, very far afield, even unto Chicago, Cook County, Illinois, in the hope that some poor fish would succeed in making a good set of castings from a very inaccurate set of patterns.

How much better off this group of "spendthrifts" would be today, if they were possessed of sense enough to realize that it would pay them to scrap their present crop of patterns, and pay good money, to good mechanics, for good patterns, that will go far to make good castings.

Error

In Mr. Parry's article on Brass Foundry Mismanagement in the September issue of THE METAL INDUSTRY, p. 408, an error caused a sentence to read, "Among the many cures suggested were . . . bigger billets. . . ." This should of course have been "bigger fillets," as all good foundrymen know.

Booth Rotating Electric Furnace

A Description of One of the Most Recent Furnaces for Melting Brass

By CARL H. BOOTH, President, The Booth Electric Furnace Company, Chicago, Ill.

The Booth Rotating Electric Furnace, to a discussion of which this paper is devoted, has many distinctive features of its own.

Records are now available from upwards of twenty successful installations, ranging in size from 250 pounds to 2,000 pounds per heat, and the results obtained easily justify the statement that the Booth Rotating Electric Furnace is a universal type of equipment, capable of handling every type of copper alley, whatever the nature and character of the material required.

Figure 1 is a line drawing showing the basis principles incorporated into the design of the furnace, and the simple electrical connections required.

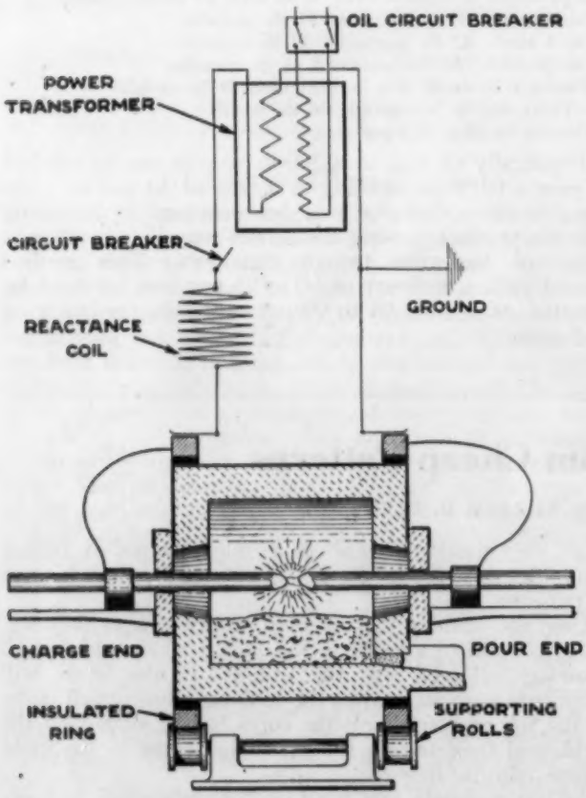

FIG. 1. LINE DRAWING SHOWING PRINCIPLES OF FURNACE

From this it will be noted that the furnace is in the shape of a cylindrical drum, for all practical purposes almost a sphere, which, from the standpoint of minimum radiating surface, is the most efficient construction to employ. The doors are located at the axis of the shell where the electrodes enter the furnace. The pouring tap is located at one end, which leaves the cylindrical walls of the shell unbroken, permitting complete rotation of the furnace. The electrical current is brought on to the furnace by the moving contact method, similar to the third rail system employed in electric railway service. These distinguishing features result in a simple type of equipment permitting great flexibility in operating conditions.

All grades and types of copper alloys have been successfully melted in this furnace. In character of material—ranging from sweepings, grindings and low grade foundry washings, up to the highest grade ingot metal and virgin pig. In analysis and composition—the metals melted include pig tin, zinc, lead, copper, yellow and red brass of every variety of analysis, monel metal, and other high temperature alloys. Lead and tin drosses have been successfully treated yielding a high recovery of pure metal at a low cost of operation.

The success of this furnace in handling such a wide range of products, can largely be attributed to the application of the principle of rotation, which is accomplished by the special patented features and methods of construction referred to above.

In melting yellow brass turnings and borings, which material is one of the most difficult to handle in any type of equipment, especially when full of dirt, oil and other foreign matter, the furnace is loaded well up on the walls at either side of the electrodes. The door is then closed one or both of the electrodes withdrawn to permit of the burning oil and moisture escaping, and the furnace placed in rotation. As the borings tumble around inside of the furnace, new surfaces are constantly exposed to the hot lining, and the oil and dirt rapidly burnt out. (It is of course appreciated that the electric furnace is more valuable as melting medium than used as a drying or oil burning vessel, and if the constant run of material charged is very heavy with oil it will soon pay in saving in furnace time alone to remove the greater portion of oil before charging. But the fact remains that, if desired, the foreign matter can be easily expelled in a simple manner before the actual melting begins.) As soon as the flame from the burning oil drops off, the rotation is stopped, the electrodes inserted, the power thrown on and the melting started. The size of the charge will determine whether it is practical to commence complete rotation. If a maximum loading has been made, experience shows that equally good results can be obtained by leaving the furnace stationery for a brief period, and then advancing the shell forward occasionally to turn over the charge, finally going to complete rotation for ten or fifteen minutes before pouring. This method prevents any breakage of electrodes. If a smaller charge has been used rotation can be started immediately. The first method had the advantage in the using of the largest practical heats, resulting in the maximum daily output. The difference in metallic shrinkage, as between the two methods, is small.

The Booth Rotating Electric Furnace is in a field by itself when treating or melting finely divided material. Metallurgists have known for years of the difficulty of getting borings, grindings, turnings and powdered products to coalesce and melt. Without complete rotation the top layer of the material simply melts over, and each small particle of the charge seems to insulate against the passage of the heat, making it necessary to supplementary stirring, or secure the melt at a greatly increased loss. With the rotating action of the Booth furnace the charge simply has to turn over, exposing all particles of the heat, producing extremely rapid melting, and with low loss and power consumption. Since metals in this form can be purchased at the lowest possible cost, the Booth Rotating Electric Furnace can show unusual economies when used on these grades of material. The demand for the furnace along these lines is rapidly opening up into many and varied fields, and not only for melting purposes, but for important reduction and refining

operations which have been waiting for the successful development of such equipment. Announcement will be reserved later for a discussion of these many and varied applications.

Recent records obtained from the Prime Manufacturing Company, Milwaukee, Wis., on their 500-pound Booth Rotating Electric Furnace, which is used almost exclusively for the melting of yellow brass turnings and borings, pouring directly into castings, are as follows:

Pounds melted per day—one shift	3,900-5,500
Average daily output	4,950 pounds
Average charge per heat	550 pounds
Number of heats per day	8-10
Number of hours' power on furnace daily	10-11
Average melting time	40 minutes
Time between heats	15-25 minutes
Average power consumption per ton	300 K.W.H.

Lining (made of good grade of arch fire clay brick) has lasted approximately 500 heats and is good for many more.

Electrode consumption per ton metal, under 6 pounds.

No records as to net metallic shrinkage, exclusive of oil, dirt and moisture, are available, but tests made on the same type and analysis of material in other Booth furnaces show that this need not exceed an average of 2%.

In melting yellow brass turnings and borings, after each heat, generally between ladles—as only a moment's time is required, all live parts of the furnace are carefully cleaned off with compressed air, which we find prevents any short-circuiting due to deposits of zinc dust. The movements of the electrodes through the cooling collars are also tested out to see that they do not stick, and any loose slag left in the furnace after pouring the heat is removed.

The treatment of yellow brass borings being much the more difficult, the melting of other finely divided materials, such as red brass borings, turnings, skimmings, washings, etc., is very easily handled, with metallic shrinkage losses averaging not more than 1 per cent. and power consumption even with small size furnace like the 500-pound unit, averaging not over 350 K. W. H. per ton, operating only one shift per day, and including all preheating.

With heavier materials, such as heavy scrap, ingots, etc., the practice followed is to hold the furnace stationery after charging until the metal has softened, then partial rotation is started, and finally complete rotation.

It has become standard practice with all Booth furnaces, since it was early discovered that only a very limited time for preheating was required, to eliminate entirely the time usually consumed with heating up the furnace in the morning. Instead where only one shift of 8-10 hours per day is run, the furnace is charged at the end of the day after the last heat is poured, for the first heat of the following day. Careful measurements with pyrometer showed that when the furnace was left empty over night, the temperature of the melting chamber in the morning had dropped to 450 degrees Fahrenheit, but when charged the night previously, the temperature of the melting chamber the next morning was 900 degrees Fahrenheit. This is good testimony to the construction of the furnace, and the excellence of the heat absorption and retention.

Records recently made on a 500-pound Booth Rotating Electric Furnace at the plant of the Enterprise Brass Works, Muskegon, Mich., melting red and yellow brass for castings, in the proportions of about two-thirds red to one-third yellow, show what can be expected when using the furnace on heavy metal:

Average pounds melted daily	4,800
Average charge per heat	600 pounds
Number heats per day—nine hours	8
Average power consumption per ton	310 K. W. H.

Records on the same size furnace at the plant of the Fulton-Harwood Brass Works, South Bend, Ind., are on the same efficient basis, although their daily average requirements for metal are less. The charge consists of only virgin pig and their own foundry scrap. Considering the fact that this furnace is not being pushed to its capacity, the showing made is exceptional, and proves clearly the ability of the Booth Rotating Electric Furnace to operate on a low cost basis, even with a reduced day's operation. We quote from a recent letter:

"Below is a monthly report of the operation of your furnace in our factory from June 9 to July 9, inclusive, using new copper, tin, lead and zinc. Analysis 85-5-5-5.

Metal melted	80,000 pounds
K. W. H. consumed	14,761
K. W. H. per ton of metal	370.8
Pounds of metal per K. W. H.	5.42
Cost of electric energy—per ton	$8.68
Electrode consumption	147.75 pounds
Electrode consumption per ton metal	3.7
Cost of electrodes per ton of metal	$0.925
Number of heats	147
Life of lining in which these heats were melted	520 heats
Cost of lining per heat of metal	$0.3846
Cost of lining per ton of metal	$0.961
Cost of electric energy, electrodes and lining (per ton of melted metal)	10.566

We do not know what the shrinkage may have been, therefore cannot furnish these figures, but in our opinion there is not the chance of shrinkage of metal in an electric furnace that there is in any of the other types of furnaces used. Considering the present unsatisfactory conditions encountered in using coke or oil, we believe the electric furnace is in a class by itself, provided the tonnage melted will warrant capacity operation of the same."

While no tests as to shrinkage have been made at this plant, under similar conditions at other plants, the metal loss has not averaged over ½ of 1 per cent.

Equally representative records are being made on a large number of 500-pound Booth furnaces, the difference in output, power consumption and shrinkage, largely being due to requirements as to pouring temperature length of pouring time per heat, etc.

Yale & Towne Mfg. Company, Stamford, Conn., recently completed thorough tests covering every phase of the operation of a 500-pound rotating electric furnace at their plant. A high pouring temperature is required due to the light weight castings made, and likewise the time between heats is lengthened out since the metal is all taken in small pots. As a consequence it was necessary to keep the power on the furnace while pouring, which made the power consumption high and slightly increased the metal loss. There were other disadvantages in handling due to the location of the furnace in their foundry. When their practice is thoroughly worked out much better records can be made.

The analysis of the metal melted was:

Copper	86.93
Zinc	9.62
Tin	1.86
Lead	1.38
Iron	0.21

Summary of the test data is as follows:

Date.	Heats.	Charge. Lbs.	Melt Time. Min.	K.W.H. to Hold Heat.	Total K.W.H. Used.	Total Time. Min.	Delay Min.	Metal Poured. Lbs.
5-25-20	7	4,060.0	317	69.8	712.4	552	7	*....
6-1-20	5	3,045.0	292	60.0	729.8	538	22	3,007.5
6-7-20	4	2,436.0	295	38.0	644.2	530	50	2,391.0
6-8-20	7	4,263.0	363	0.0	783.8	608	41	4,209.5
6-14-20	6	3,654.0	305	13.0	791.2	545	21	3,620.5
6-15-20	5	3,045.0	254	51.0	595.0	501	38	3,010.5
6	34	20,503.0	1,826	232.6	4,256.4	3,274	174	16,239.0
Av. per ton, 10.252 tons	..	.....	178	22.7	415.2	319	16.9	....
Av. per heat			53.7					

*Box of gates missing

Amount of metal melted in 6 working days	20,503 lbs.
Number of heats	34
Average weight of heat	603 "
" melting time per heat	53.7
" time between heats	37.4
" time metal melted per day	3,417. lbs.
" time K.W.H. per ton	437.9
" time Electrode consumption per ton	6.55 lbs. (2.8 lbs. nipples
Gross shrinkage	1.24%
Non-metal in charge (Approximately)	0.13%
Net Metal Loss	1.11%

reference to the high power consumption shown especially on June 1, 7, and 15, the statement is made that this was materially increased by the shortage of labor, as heats had to be held from ten to twenty-five minutes until men were available to carry the metal—whereas the results of May 25, and June 8, show the increased capacity and decreased K. W. H. per ton due to elimination of these delays.

Figure 2 shows the 500-pound Booth Rotating Electric Furnace at the plant of the Fulton-Harwood Brass Works, South Bend, Indiana. This design is standardized and duplicate equipments are operating in

FIG. 2. POURING A HEAT AT FULTON HARWOOD BRASS WORKS, SOUTH BEND, IND.

Special notes regarding these tests made by the engineer referred to, call attention to the fact that "The average quantity of metal melted per day, 3,417 pounds in 9 hours and 6 minutes, or at the rate of 4,000 pounds in 10 hours and 39 minutes, does not give a fair estimate of the capacity of the furnace as the results were materially affected by the shortage of labor." Also, commenting on the average of 37.4 minutes required for charging and pouring, he says, "this 37.4 minutes was considerably longer than should have been required due to the nature of the charge, light scrap, and the shortage of labor. Under normal operating conditions, with regular men for carrying the metal, this time could be materially reduced and the capacity of the furnace proportionately increased." The analysis of metal before and after pouring show that the loss was mostly zinc and that the actual value of same was $2.43 per ton melted. Examination of the castings made from the metal melted in the Booth furnace showed that there were no rejections due to the metal. With all the other foundries referred to, and in a great many other representative plants.

It is significant to note that, even with a rate of power in practically all of these plants, of at least 2 cents per K. W. H. and occasionally up to 3 cents, the cost, per ton of metal melted, for electricity, is no higher than present day costs for coke, oil and gas. As the use of crucibles for melting is eliminated with the Booth Furnace, and the total upkeep and repair costs on this small 500-pound furnace will not average over $2.00 per ton of metal melted, which total is considerably lower than the cost of crucibles alone, the large savings made in metal losses and in labor, show a handsome margin in favor of the Booth Rotating Electric Furnace.

The brass foundry needs the small efficient melting unit. The mixtures required in the day's run are quite varied. Large heats can not be handled to good advantage for many reasons, but principally because of the difficulty in keeping the metal up to temperature, and

the long shut-downs between heats. The records presented above show that it is practical to use a small arc furnace for intermittent daily operation, and secure cost records almost as low as with larger size furnace. And the overall result is far superior due the greater flexibility in handling, the ability to make short heats, follow one heat of a certain mixture with another heat of an entirely different analysis, run, if necessary, only a few hours per day, but not at a heavy penalty in cost, use any grade of material from borings to pig metal, and thus effect the maximum economy in metal used.

For the brass melter who has a large number of mixtures or whose daily output is limited, a Booth Rotating Electric Furnace of still smaller holding capacity can be obtained. This is known as the 250-pound size. In all the details of its construction it is identical with the 500-pound furnace, and the power input is proportioned so that the same speed of melting results.

A record of a recent day's run on a 250-pound furnace at the plant of the Hill Pump Valve Company, Chicago, will be interesting.

All heats were Red Brass 85-5-5-5

Heat No.	Power On.	Power Off.	K. W. H. Used.	Weight of Charge Lbs.	Time Between Heats. Min.
1	6:00	8:35	125	346	25
2	9:00	9:58	50	348	25
3	10:22	11:25	52	351	24
4	11:48	12:50	52	340	23
5	1:15	2:15	50	362	25
6	2:40	3:40	53	384	25
7	4:07	5:00	48	371	27
			430	2502	

Average power consumption—343 KWH per ton (no preheating required).

On each heat from three to five minutes taken to skim through door. Zinc added at this time. Metal used—old scrap copper (bearing blocks). Pouring time—10-12 minutes between heats. Remainder—clean electrodes and coolers, and charging furnace.

Leitelt Brothers, Chicago, where one of these furnaces has been in operation for over one year and one-half, can produce an abundance of records showing equally as low results. Many heats on yellow brass scrap have shown as low a power consumption as 240 K. W. H. per ton, while on yellow brass turnings and borings, 210 K. W. H. per ton has not been uncommon. Linings have lasted almost 900 heats, none less than 600. This represents a cost of less than 10 cents per heat conservatively 75 cents per ton. Accurate weighing of electrodes each day show only 3½-4 pounds consumption per ton of metal, including breakage. Shrinkage has not averaged over ¾ of 1 per cent on red brass, nor more than 1.4 per cent on yellow. Heats as small as 100-pounds have been made showing only a slightly higher average for all times when run to rated capacity. The most efficient basis naturally is to charge a maximum of metal per heat, which for this furnace would be about 380 pounds.

Nordyke & Marmon Company, Indianapolis, Ind., are using one of these 250-pound furnaces for making their most difficult alloys and castings, including silicon bronze and other special mixtures. A considerable portion of the time the furnace runs for 16 hours per day. Many heats of red brass on this basis have been made at the rate of 270 K. W. H. per ton, which is a good record for a 2,000-pound furnace.

The 2,000-pound Booth Rotating Electric Furnace, at the plant of the Michigan Smelting & Refining Company, is the first electric melting furnace of the indirect arc, drum-type method of construction to be equipped with automatic electrode control. Before this was placed in operation it was freely predicted that such apparatus could not be used successfully, that the electrodes would stick and that there were peculiar short-circuiting conditions in the furnace caused by zinc and other metallic vapors which would make it inoperative. However, the automatic control feature has worked without any difficulty, from the very first heat made in the furnace; and for the largest portion of the time the furnace has been melting extremely dirty and oily yellow brass turnings and borings, which material certainly would product furnace conditions making it most difficult for this device to operate, if there was any question of its doing so.

All Booth Rotating Electric Furnaces are designed so that automatic control of the electrodes can be used. This feature soon pays for itself in saving in labor cost especially when more than one furnace is installed. A small ¼ HP, DC, ball-bearing motor, controlled by a standard General Electric or Westinghouse control panel comprises the equipment. Either 220 or 110 volt DC can be used.

LINING

One of the special features of the Booth furnace is the simplicity of the lining, and the quickness which with complete repairs can be made—not more than 24 hours being needed from the time the last heat is taken until the new lining is in place and the furnace ready to run,

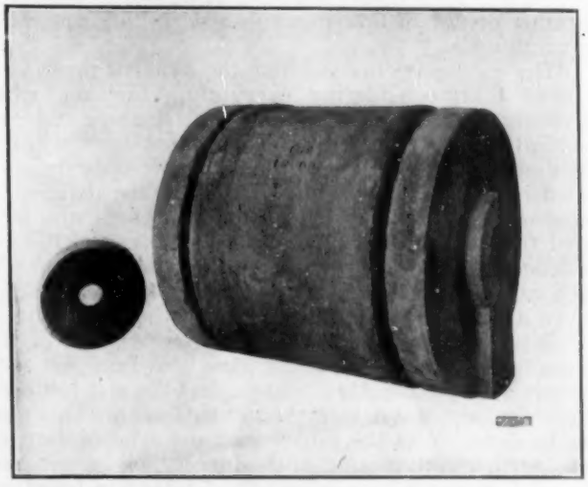

FIG. 3. SPECIAL LINING FOR BOOTH FURNACE

in other words, no long or costly shut-downs. Advantage is taken of the drum-type construction of the shell, so that by removing either end section, by simply unbolting from the shell, the new lining can be quickly slipped into the place. This lining comes in only three pieces, outside of the one brick required for each door, viz., either one or two big circular brick for the cylinder itself, and one brick on each end. The simplest manner of putting the lining in place is to turn the shell up on end like a barrel, lower each section of the lining into position, after which heat-insulating material is tamped into place between the lining and the shell. This method of lining has many advantages. It is to all intents and purposes a one piece lining, which makes it practically impossible for the melted brass to work its way back to the shell, impregnating the entire lining, which is frequently the result where linings are made with numerous joints. This is the only form of furnace lining that permits all fire-clay joints to be made while in a horizontal position, and thus avoids clay running out of the joints. The entire lining, due to the complete rotation of the furnace, is covered by the metal bath, resulting in even wear and expansion of refractories, longer life for the same grade of material, and low repair costs.

Melting Brass With Fuel Oil

An Analysis of Costs and Comparison With Other Fuels, Showing That Fuel Oil is the Most Economical —Part 1

Written for The Metal Industry by S. D. RICKARD Consulting Engineer, Wayne Oil Tank and Pump Company

A large brass manufacturer has recently published a very interesting booklet in which it is pointed out that the construction of the present day pit furnaces for melting brass is almost identical with similar furnaces constructed in the 16th century. Only a very slight improvement has been made during the last four hundred years.

Within the last few years, however, many new furnaces of the above ground, tilting crucible, or non-crucible, type have been placed on the market. These furnaces are constructed for use with oil, coal, coke, or electricity as fuel. The majority of such furnaces have marked a considerable advance in the melting of brass.

The electric furnace has probably received the greater proportion of attention given these new types of furnaces, but very little accurate data seems to be available as to the comparative cost of the different fuels for producing a definite amount of work. If this question can be determined, it is then simply a matter of figures to determine whether or not an investment in new melting equipment is worth while.

After exhaustive investigation the writer is firmly convinced that, considering everything, **fuel oil, when properly used,** is today the most satisfactory and economical fuel for the melting of brass and other non-ferrous metals. At the present time oil is probably the most extensively used fuel for this purpose; but the above statement will be questioned by a few foundrymen who have tried fuel oil and have gone back to the use of the old fashioned pit furnaces, or installed electric furnaces. In such cases, the writer is convinced that fuel oil was not given a **fair trial.** Careful records of the consumption of oil per hundred pounds of brass melted, and of the percentage of metal lost, might have been kept, but such records are absolutely worthless unless the test has been efficiently carried out from every standpoint. This cannot be done unless the proper size and type of furnace is selected, and the design of the furnace, oil burner, and the oil burning system behind the burner are based on definite scientific principles, correctly applied.

An inspection of a great many installations of oil burning equipment demonstrated the fact that the use of oil as a fuel had not been free from the waste and inefficiency prevalent in this country in the use of almost all raw materials. It is safe to say that a large majority of these systems were being operated far below the percentage of efficiency possible with this fuel. Some of the furnaces were merely converted from coal to oil burning; other furnaces seemed to be home made, or designed with no regard for well known scientific principles; the burners were of all sizes and types; and the oil burning systems behind the burners seemed to be simply a collection of blowers, pumps, tanks, etc., all of very good construction and design in themselves, but with no coordination between them, without proper accessories, and not properly selected for the work.

In order to approach this subject properly we should first consider the comparative heat value, or B. T. U. (British Thermal Units) of the principal fuels. The same liquid or solid fuel will vary somewhat in its heat value, but the following figures are sufficiently average for estimating purposes:

1 Pound Fuel Oil contains.....	19,200	B.T.U.
1 Pound Anthracite Coal contains..	13,000	"
1 Pound Coke contains.....	13,000	"
1 Cubic Foot City Coal Gas contains	600	"
1 Kilowatt Hr. of Electricity contains	3,412	"

By comparing coal or coke with fuel oil we find that approximately 1 ton (2,000 pounds) of good coal or coke contains the same number of heat units as 180 gallons of fuel oil. However, it has been found in actual practice that the number of gallons of oil required to do the same amount of work as 1 ton of coal varies from 75 to 150 gallons, depending on the kind of work to be done. In brass melting, when using furnaces each built for the fuel to be used, and each properly operated, it has been found that 100 gallons of oil will do the same amount of work as 1 ton of good coal. This is due to the fact that with oil there are no ashes and so no loss of heat value in that direction; the loss of heat up the flue is considerably reduced; and the temperature can be easily, quickly, and accurately controlled. The furnace can be brought up to the melting temperature in a much shorter time, and the consumption of fuel is immediately stopped as soon as the melt has been accomplished.

If we base our cost figures at 12c. per gallon for fuel oil, and $15.00 per ton for coal, we see that $12.00 worth of oil is equivalent to $15.00 worth of coal. Then considering the increase in production afforded by much quicker melts, the better castings secured with less skill upon the part of the melter, the comfort afforded the operator, the elimination of the cost and storage space for handling coal and ashes, and the saving of crucibles in the tilting crucible type of furnace, it is evident that oil is a much more economical fuel than coal or coke.

If we consider artificial city coal gas as a fuel, we find that about 4.2 gallons of oil are equivalent to 1,000 cubic feet of gas. With furnaces of the same type and size and each properly constructed for the fuel used, the theoretical calculations given above will work out in this way in actual practice: roughly, 4½ gallons of fuel oil equal 1,000 cubic feet of gas. City gas has been comparatively low in cost, but with the increased cost of coal and operating expenses the selling price of gas is bound to increase. Figuring oil at 12c. per gallon and gas at $1.00 per 1,000 cubic feet, we find that 54c. worth of oil will do the same amount of work as $1.00 worth of gas.

It must be frankly admitted that the electric furnace, when properly designed and operated, possesses as great advantage in rapidity of melting, comfort for operator, etc., as the oil or gas fired furnace. The principal points of comparison are the operating expense, the upkeep, and the first cost of the necessary equipment to afford a certain production. One strong claim for the electric furnace is the low percentage of loss of metal entailed by its use.

By referring to the above table we find that one gallon of fuel oil is equivalent in heat value to about 42 kilowatt hours of electricity. However, in order to be fair we must consider that the electric furnace is more efficient than the oil or gas fired furnace. We may consider that both types of furnaces are so constructed that the loss of heat by radiation from the shell is the same in each case; but an electric furnace is entirely closed while melting, while with the oil or gas furnace some heat is being continually discharged through the furnace vent.

It is often claimed that the electric furnace is 100 per cent efficient. This is obviously unfair as there is bound to be some loss of heat through radiation from the shell and when opening the furnace for charging or pouring. Otherwise such a furnace would be just as hot in the morning as when shut down at night.

More conservative claims have been made that the electric furnace is 85 per cent efficient and that properly constructed oil or gas burning furnaces are 60 per cent efficient. However, if we calculate the efficiency of these two furnaces on a purely theoretical basis, basing our figures on 1½ gallons of oil to melt 100 pounds of brass, and 20 kwh. of electricity to melt 100 pounds of brass, we find that the oil furnace is approximately 9 per cent efficient and the electric furnace approximately 30 per cent efficient.

Then, basing our calculations on figures given above, we find that in actual operation it will require approximately 12.66 kwh. of electricity to equal one gallon of fuel oil. Some time ago the lowest industrial rate for electric power in a very large western city was 3c. per kwh. At that rate one gallon of oil at 12c. per gallon would be equivalent to 40c. worth of electricity. Therefore, if it took 18c. worth of oil to melt 100 pounds of brass, it would cost 60c. for electricity to melt the same quantity of brass.

Now, considering the saving in loss of metal, some oil burning furnaces have been developed to the point where the loss of metal is not more than 2 per cent greater than the loss in electric furnaces under the same conditions. Of course, we must consider the cost of moulds, labor, etc., the same in either case. Therefore, only the value of the metal in the castings should be considered and not the cost of the complete castings themselves. So, considering this metal is worth $15.00 per hundred pounds, a 2 per cent loss would amount to 30c. Deducting this 30c. loss from the cost of the electricity required to make the melt (60c.), we find that 18c. worth of oil is equivalent, considering melting losses, to 30c. worth of electricity.

THE OIL BURNING SYSTEM

If we are to secure the most efficient and satisfactory results, the equipment necessary to burn oil properly must be considered as a unit—one complete system; and each item of the complete system must be specially designed for the purpose and selected and installed accordingly. In fact, every item must fit, or coordinate, with every other item.

It is quite an engineering problem to assemble and install a complete oil burning system, as many scientific principles are involved and must be applied. This work should be placed in the hands only of those who are practically and technically qualified to undertake it.

A complete oil burning system consists principally of the following items: (a) The furnace or combustion chamber where the oil burns and where the heat that is generated is used; (b) the oil burned which atomizes the oil and projects it into the furnace; (c) the oil pump which supplies oil to the burners; (d) the oil storage tank, or tanks; (e) the blowers and certain special fittings and accessories. However, the means of supplying oil and air to the burner is the part of the equipment usually referred to as "The Oil Burning System."

The most essential points in an oil burning system are the following:

(1) That it supply oil in sufficient volume to the burner in a clean and properly heated condition, and under a constant and automatically regulated pressure, free from pulsations.

(2) That is supply air in sufficient volume to the burners in a clean and fresh condition, and under a constant and automatically regulated pressure, free from pulsations.

(3) That the air and oil supply be connected, or coordinated, in some way so that should the air supply fail the oil supply will be instantly cut off.

The burning of oil is in reality the continuous feeding of two ingredients (oil and air) in proper proportion into the combustion chamber in such a manner that a chemical mixture will be secured and good combustion is the result. It will be appreciated that whenever the oil or air pressures are not constant, or pulsate, it is impossible to secure good combustion. In short, whenever the oil or air supply pulsates, it is safe to say that just 50 per cent of the time good combustion is not obtained. The pressures of oil and air must also be automatically regulated; or otherwise, whenever a burner is started up or shut down it will be necessary to adjust all of the other burners in the system.

Whether or not good combustion is being secured can only be determined by analyzing the flue gases. However, when a red, smoky flame is produced, it is evident that an excess of oil is being burned. On the other hand, when the flame is intensely white and sharp, an excess of air is usually the cause. It must be possible with an oil burning system to obtain sufficient heat, and properly regulate the combustion, by simply turning the oil and air valves so that neither a smoky red fire nor an intensely white sharp flame is produced.

When the air pressure fails and the oil continues to discharge into a hot furnace, the flame blazes up to the roof, which has caused some bad fires. Therefore it is of a great deal of importance that there be some connection between these two sources of supply.

The above conditions can only be overcome by the selection and installation of systems and equipment as described below.

LOW PRESSURE SYSTEMS

Low pressure oil burning systems have been found to be the most advantageous for use with melting furnaces. These systems consist principally of a compressor or blower for furnishing the necessary air in sufficient volume for good combustion and under sufficient pressure for atomizing the oil; an oil pump for drawing the oil from the storage tank and delivering it to the burners; and such special fittings as air chambers, air receivers, relief valves, pressure gages, etc.

Fig. 1 illustrates a low pressure system, in which a positive pressure type of blower is used.

With the positive pressure type of system, as shown in Fig. 1, the air is drawn in from out of doors so that clean, fresh air is procured and discharged into the air receiver. From this point it is discharged into the distributing pipe to the burners under a pressure of about 1½ pounds per square inch, as shown by the gage on the receiver. As whatever air is compressed with this type of blower must escape in some way, the air receiver is fitted with relief or safety valves.

The oily pump draws the oil from the underground storage tank through suitable suction line strainers and discharges it under a pressure of five pounds into the distributing pipe to the burners. This pump is fitted with an air chamber, relief valve and pressure gage. Any excess oil which the pump discharges is carried back to the tank from the relief valve by a separate pipe. The system is also installed with a by-pass valve so that when opened, in case of fire or a broken pipe, the complete system may be drained back to the tank.

It will be noted that the pump is driven by a chain and sprocket wheels from the shaft of the blower, so that

should the blower stop the pump must also stop, thereby avoiding the danger of pumping unatomized oil into a hot furnace.

It will be noted in the system shown in Fig. 1 that the tank is placed underground below the burner level.

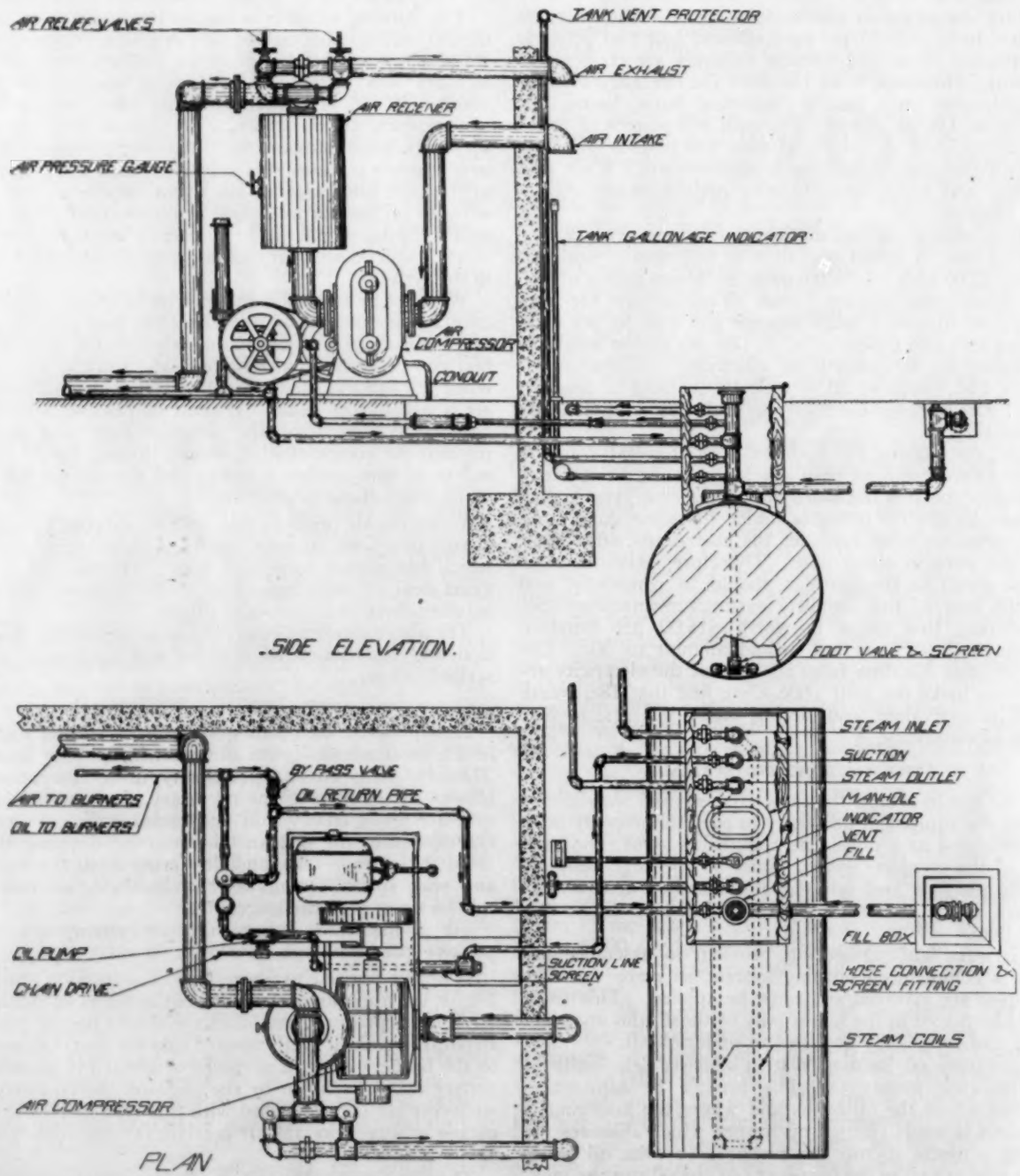

FIG. 1.—LAYOUT OF OIL SYSTEM, LOW PRESSURE, USING POSITIVE PRESSURE BLOWER

Systems where the oil is fed to the burners by gravity from an overhead storage tank, or from stand pipes, as well as systems where the oil is forced to the burners by means of compressed air on the oil in the tank, are all dangerous and inefficient and their use is seldom approved by the insurance companies.

When it is impossible to place the main storage tanks below ground or below the level of the burners, a small 5 or 10 barrel reservoir tank should be placed underground below the main storage. This reservoir tank is then fed by gravity from the overhead tanks. Just inside the small reservoir tank is placed a float valve. This valve automatically closes whenever the oil in the small tank reaches a certain level. The suction and return pipes should run from this small underground tank in the usual manner. In this way the danger of flooding a building with oil is avoided.

In fact, all oil pipe should slope from the burners back to the pump, and from the pump back to the tank, with a by-pass valve connected into the oil return line at the pump so that the whole system can be drained. The overflow pipe from the relief valve and by-pass valve is always one pipe size larger than the suction line.

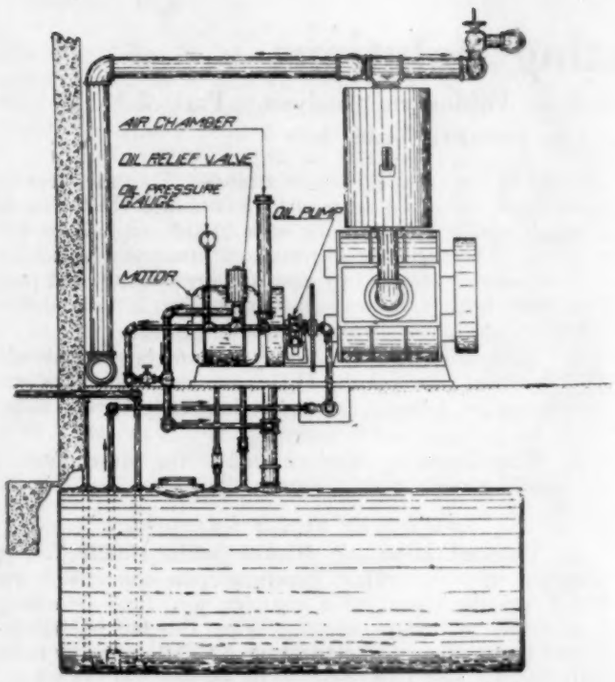

FIG. 2. FRONT ELEVATION OF LAYOUT SHOWN IN FIG. 1.

In the rare cases where a piston type of air compressor is used for supplying air to oil burners, it is advisabie to supply the oil to these burners by means of a small duplex piston steam pump. This pump can be run by compressed air from the air compressor in place of steam. In this way the two units will be coordinated and start and stop together.

FURNACES

Each fuel, such as oil, gas, coal, wood, etc., requires a different type of combustion chamber. This is due to the variation in the physical form of the different fuels as well as the variation in time required for each fuel to be converted into combustible gases.

A furnace designed for use with a certain fuel cannot be used to advantage with any other fuel unless proper alterations are made in the combustion chamber. Often these changes are impossible without entirely rebuilding the furnace and in most cases it is most economical to install an entirely new furnace.

Sometimes an oil burning furnace is referred to as simply "a box of iron lined with fire brick with a hole in the middle." Too often many furnaces are just this, and it is even possible to heat metal in such furnaces. However, the design of an efficient furnace is based on definite scientific principles covering the size of the combustion chamber and the number of cubic inches of space to be evenly heated at a certain temperature; the size, number and position of the burner holes, the number, area and position of the vent ports, etc. In order to secure the maximum of life under hard usage, the construction of the furnace must be correct. The steel or iron shell must be capable of withstanding the expansion and contraction of the lining, and this fire clay lining must be of proper grade and thickness for the work to be done.

The sizes and the type of furnace to be selected is a matter that must be given very careful consideration. The furnace should be neither too small nor too large for the work. Your calculations should be based on the quantity of metal to be melted at one heat, and the speed of production desired. Although the first cost is higher, several small furnaces are sometimes more efficient than one large furnace.

It is very bad practice to attempt to use one furnace for different kinds of work where there is a material difference in the heat required.

This article will be concluded in an early issue.—Ed.

The Electro-Deposition of Brass From Cyanide Solutions

Abstract of a Paper Presented at the Thirty-eighth General Meeting of the American Electrochemical Society, Held in Cleveland, September 30 to October 2, 1920.

By ALFRED L. FERGUSON, Dept. of Chemistry, University of Michigan, and EARL G. STURDEVANT.

The work herein reported is from a thesis presented by E. G. Sturdevant to the Faculty of the Graduate School of the University of Michigan in part fulfilment of the requirements for the Degree of Doctor of Philosophy.

SUMMARY.

As a result of this work the following statements may be made:

(1) Increase in the ratio of copper to zinc in the solution increases the percentage of copper in the deposit. A solution in which the ratio of copper to zinc is 4.2 gives a deposit of about 65 per cent copper (ratio 1.9).

(2) Solutions of high metal content are more satisfactory than dilute solutions. A solution containing thirty-five grams of metal per liter, in the above ratio, gives satisfactory deposits.

(3) Increase in temperature decreases cathode polarization and consequently increases the percentage of copper in the deposit.

(4) Increase in current density produces a gradual decrease in the percentage of copper in the deposit. At current densities greater than 0.3 ampere per sq. dm., the deposit becomes granular, non-adherent, and dull.

(5) Increase in free cyanide does not increase anode efficiency, but does decrease cathode efficiency. Its influence on the percentage of copper in the deposit is variable.

(6) Slightly acid substances increase the percentage of copper in the deposit. A weak acid may be used in place of any of the acid substances that have been recommended.

(7) Slightly alkaline substances decrease the percentage of copper in the deposit. The presence of slightly alkaline substances is beneficial in that it improves the appearance of the deposit.

(8) Neutral substances have no influence on the deportment of the cyanide brass plating solution.

(9) Brasses which vary in composition from 62.3 to 85.0 per cent of copper dissolve as such anodically. The efficiency of corrosion is about the same as that of copper.

(10) Decided depolarization of zinc by copper takes place and makes possible the deposition of brass from solutions in which the potentials of the two metals are not equal.

(11) Electro-deposited brasses which vary in composition from 37.6 to 82.0 per cent copper give nearly the same potentials in a plating solution. These potentials are nearer to that of copper than to that of zinc.

Analysis of Plating Solutions

A Description of the Gallon Assay Method or Volumetric Analysis. Part 2.*

Written for The Metal Industry by JOSEPH HAAS, Jr.

3. Determination of Free Acid. When an acid and a base are brought together in the presence of an indicator, a change in color of the solution denotes that the titrated substance has had its properties destroyed. The amount of Na_2CO_3 as given in the table makes a solution of such strength that 1 cc will neutralize 0.1 decigram of 1.84 sp.gr. H_2SO_4, so that the readings on the burette numerically equal the amount of that acid in Avoid. ozs. Measure out 13.4 cc of the solution in a beaker and dilute to 100 cc, add 3 or 4 drops of 5% of methyl orange. The solution will be cherry red. Place the beaker in a white surface, and titrate with Na_2CO_3 solution. The exact end point is indicated by the solution turning a golden yellow. This end point is difficult to obtain; however a slight cloudness may be taken as the end point. Should the green precipitate be too heavy it is an indication that too much Na_2CO_3 has been added, and a new portion of the solution must be analyzed.

ANALYSIS OF CYANIDE COPPER SOLUTIONS

1. Determination of Copper. Take 13.4 cc of the solution and dilute to 50 cc. Add slowly dilute H_2SO_4 to decompose the cyanides and heat to evaporate cyanogen and to dissolve CuCN precipitate. Small additions of acids may be necessary to dissolve and decompose the CuCN. Add water to replace that evaporated. When solution is complete dilute to 100 cc and use any method given above for acid solutions, to determine the amount of copper.

2. Determination of Free Cyanide. Take 13.4 cc of the solution and determine as explained under Silver Solution.

ANALYSIS OF ZINC SOLUTIONS

1. Determination of Zinc with $K_4Fe(CN)_6$. The method depends upon the principle that $K_4Fe(CN)_6$ precipitates zinc from solution as $K_2Zn(Fe(CN)_6)_2$. Complete precipitation is indicated when ammonium molybdate paper is tinged brown. This paper is made by cutting strips of filter paper and allowing them to become saturated with a 20 per cent ammonium molybdate solution. The papers are placed in a small bottle, after drying, and taken out as needed.

Acid solutions. To 1.34 cc of the solution NH_4OH is added to produce a faint precipitate; then add conc. HCl to just dissolve the precipitate, and 2 cc in excess. Dilute to 100 cc and titrate with the standard $K_4Fe(CN)_6$ solution until a drop of the zinc solution produces a brown stain on the indicator paper.

Cyanide solutions. Boil 13.4 cc of the solution with conc. HCl until all the cyanides are decomposed. Then proceed as explained with acid zinc solutions.

2. Free Acid. Take 13.4 cc of the solution and determine the acid as explained under copper solutions.

3. Free Cyanide. Take 13.4 cc of the solution and determine the cyanide as explained under silver solutions.

ANALYSIS OF BRASS AND BRONZE SOLUTIONS

1. Determination of Copper. Take 13.4 cc of the solution and add 15 cc of conc. HCl and boil until a clear solution is obtained. Dilute to 75 cc and heat the solution. When moderately warm H_2S gas is passed in until the copper is completely precipitated, as CuS. The ppted CuS is filtered off and washed with H_2S water several times. The filtrate is set aside for the zinc determination. The filter containing the CuS is removed from the funnel and the CuS washed into a 250 cc beaker. The small amount of CuS that cannot be removed from the filter by washing is dissolved by pouring hot dilute HNO_3 on it. Enough acid is added to the bulk of the sulphide to dissolve it. The excess of nitrous acid fumes are boiled out and the solution filtered to separate any sulphur that may have been formed. The copper is now ready to be determined by any of the methods already given.

2. Determination of Zinc. The filtrate from the CuS is boiled to expel the H_2S, and then the rest of the determination follows the method already given under zinc.

3. Free Cyanide. Determined in the same method as already given.

ANALYSIS OF NICKEL SOLUTIONS

1. Determination of Nickel with NaCN. The principle of this method depends upon converting the nickel ions to a part of a complex ion, thus removing them from the field of action. When this has been completely accomplished, the titrating NaCN begins to react with the indicator 13.4 cc of the nickel solution are taken; about a gram of ammonium tartrate is added to prevent subsequent precipitation of Fe should it be present. The solution is carefully made alkaline with minimum NH_4OH and the solution diluted to 100 cc. As an indicator 5 cc $AgNO_3$ are added and also about 1 cc 2 per cent KI, which will throw down the silver as AgI. The solution is then titrated with the standard NaCN at 20 deg. C. When all Ni has combined with NaCN the precipitate will begin to be dissolved by the excess NaCN. This may be looked upon as the temporary end point. Since an excess of NaCN is usually added to dissolve AgI, this excess is taken up by running in $AgNO_3$ until a precipitate appears that is just cleared up by a drop of NaCN. The number of cc of $AgNO_3$ and NaCN used are noted.

Sample Calculation.

24.75 cc NaCN used in titration.
8.35 cc $AgNO_3$ used in titration.

16.40 cc NaCN used to combine with Ni.
1.0 cc NaCN = 0.1 decigram Ni.
16.40 cc NaCN = 1.64 decigram Ni = 1.64 ozs. Avoid. Ni per gallon.

2. Free Acid. Due to the fact that various acids may be present in nickel solutions, it is impossible to make up a standard solution that will give accurate results. Therefore only the following qualitative methods are given:

Litmus—Blue litmus turns red; this shows that free acid is present, but leaves one ignorant as to what acid is present, or what its derivation may be. Red litmus turns blue—indicates that the solution has turned alkaline.

Red Congo is not changed by H_3BO_3, but is turned blue by free H_2SO_4. If this happens, it is an indication that free H_2SO_4 is present besides H_3BO_3.

Tropaeolin—If the bath should contain citric acid, the above method is again insufficient, as citric acid colors red congo blue the same as does H_2SO_4. Tropaeolin paper is not altered by citric acid, but is turned violet by free H_2SO_4.

3. Chlorine Content Determined by $AgNO_3$. Since through the aid of chlorides one is enabled to assist in the solubility of the anodes and thereby keep the Ni content constant, it is a good plan when once the chlorine has been

*Part 1 was published in The Metal Industry for September, 1920.

determined that is necessary to aid the solubility of the anodes, to keep it so. To 13.4 cc of the solution add Na_2CO_3 solution, if acid; if neutral or alkaline, make only slightly alkaline. Add 2 or 3 drops of a 10 per cent K_2CrO_4 solution and dilute to 100 cc. Titrate with the standard $AgNO_3$ solution. AgCl is precipitated and the end point is indicated by the appearance of a faint red coloration, showing the formation of silver chromate—Ag_2CrO_4.

ANALYSIS OF GOLD SOLUTIONS

1. Determination of Gold by Iodine Method. 12.2 cc of the solution are boiled with HCl until all the cyanides are decomposed. KI is now added until AuI first precipitated is dissolved. A clear starch solution is added which gives the solution a deep blue color. This color is removed by the addition of the standard $Na_2S_2O_3$ solution. The standard I_2 solution is now run in until the solution takes a faint rose color which indicates the end point.

Sample Calculation.

0.99 cc $Na_2S_2O_3$ used in titration.
0.24 cc I_2 used in titration.

0.75 cc $Na_2S_2O_3$ actually used in titration.
1.00 cc $Na_2S_2O_3$ = 1 dec. Au.
0.75 cc $Na_2S_2O_3$ = 0.75 dec. Au = 0.075 ozs. Troy Au per gallon.

2. Free Cyanide. Free cyanide is determined by the usual method.

ANALYSIS OF LEAD SOLUTIONS

1. Determination of Pb with $Na_2S_2O_3.5H_2O$. (a) Cyanide and other alkaline solutions. To 13.4 cc of the solution add dilute H_2SO_4 to precipitate the lead as lead sulphate ($PbSO_4$) and allow to cool thoroughly.

(b) Acetate, fluoborate, fluosilicate solutions. To 13.4 cc of the solution add H_2SO_4 to precipitate the $PbSO_4$ and allow to cool thoroughly.

The lead sulphate in either case, after washing, is dissolved in:

$HC_2H_3O_2$ (99 per cent)	30 cc
NH_4OH (conc)	15 cc
H_2O	60 cc

Boil the subsequent solution obtained; filter, and wash filter with boiling water. The solution containing the Pb is neutralized to a heavy precipitate with Na_2CO_3, and then cleared with $HC_2H_3O_2$. Add $K_2Cr_2O_7$ to completely precipitate all lead as $PbCrO_4$. Boil precipitate until it becomes orange colored and readily settles out. Decant the clear supernant liquid through a filter and wash $PbCrO_4$ in the beaker until it is free of chromates. To beaker containing the precipitate add 15-20 cc of 10 per cent KI. Dissolve the residue on the filter with warm HCl (1:1) allowing the drippings to fall in the beaker containing the precipitate and the KI. Wash the filter carefully with hot water to remove all the chromic acid, allowing the washings to enter beaker containing the lead. Now pour the mixture into a six (6) inch evaporating dish or place the beaker on a white surface and add the standard "hypo" solution until the mixture in the dish is of a yellowish green color and then add starch paste and titrate till the color is discharged.

ANALYSIS OF BLACK NICKEL SULPHO-CYANATE SOLUTIONS

1. Determination of Ni with NaCN. 13.4 cc of the solution are measured out and diluted to 25 cc. Two (2) grams of ammonium tartrate are added to prevent any zinc or iron from interfering with the accuracy of the results. The solution is made slightly alkaline with NH_4OH, and the solution diluted to 100 cc. Add 5 cc of standard $AgNO_3$ and about 1 cc of 2 per cent KI to act as indicator. The solution is now ready to be titrated at 20 deg. C. with the standard NaCN solution in the same manner as the regular Nickel Solution.

2. Determination of Zn with $K_4Fe(CN)_6 3H_2O$. 13.4 cc of the solution are taken and diluted to 25 cc with water. Then NH_4OH is added until alkaline. If the solution is already alkaline no ammonia need be added. Now it is necessary to remove the nickel. Boil the solution and acidify with acetic acid, and then add 1 per cent alcoholic solution of dimethylgloxime till precipitation is complete. Gently heat the solution, making sure that the solution contains a slight excess of acetic acid. Allow the solution to stand for one and one-half hours and then filter. Wash the precipitate, collecting the washings with the filtrate, which contains the zinc. The filtrate is neutralized with NH_4OH to produce a slight precipitate; conc. HCl is added to just dissolve the precipitate and 2 cc in excess. Dilute to 100 cc and titrate with the standard $K_4Fe(CN)_6.3H_2O$ in the same manner as was done with zinc solutions.

3. Determination of Sulpho-Cyanate with $AgNO_3$. This method depends upon the same principles as that of the determination of Ag with NaCNS, only here the process is reversed. Take 13.4 cc of the solution, make slightly acid with dilute H_2SO_4 and dilute to 100 cc. The nickel need not be removed, as the solution is so slightly green that the reaction is not interfered with. Add two drops of ferric alum as indicator, which turns the solution brown colored; titrate with standard $AgNO_3$ solution until the brown color disappears. The reading will give the amount of CNS. To convert to NaCNS multiply by 1.396; to KCNS by 1.673; to NH_4CNS by 1.311.

ANALYSIS OF ARSENIC SOLUTIONS

1. Determination of Arsenous Oxide (As_2O_3) in Arsenic Black Solutions. The following method of analysis is to be applied to only those solutions that arsenic dissolved in cyanide. The determination of arsenous oxide by this method depends upon the fact that when arsenous acid is brought in contact with iodine in the presence of water and free alkali, it is converted to arsenic acid, and the blue color does not appear until all the arsenous acid has been converted to arsenic acid; 13.4 cc of the solution are treated with dilute HCl to destroy the cyanide. Then concentrate the solution to about 15 cc. To dissolve any precipitated arsenic, concentrated HCl is added and the solution is gently heated to bring about solution. Add 2 grams of KI and boil until all iodine vapors are dissipated. The arsenic acid (H_3AsO_4) reduced to arsenous acid (H_3AsO_3). Add 5 cc of glycerine and allow to cool; Na_2CO_3 solution is added to neutrality, then 20 cc conc. sodium bicarbonate solution ($NaHCO_3$); dilute to 100 cc and a little starch solution and then titrate until a blue color appears with the standard iodine solution.

ANALYSIS OF CYANIDE BLACK NICKEL SOLUTIONS

Take 13.4 cc of the solution and dilute to 25 cc; add concentrated HCl to precipitate and decompose cyanides. Heating will be necessary to bring about solution and also occasional additions to acid. After solution is complete, pass in H_2S as long as precipitation occurs. Filter; precipitate contains sulphides of arsenic and copper. Wash precipitate and collect washings with filtrate and set filtrate aside.

1. Determination of Arsenous Oxide. The precipitate on the paper is thoroughly digested with warm NaOH, which dissolves out the arsenic; filter and wash precipitate, collecting the washings with the main arsenic filtrate. Acidify solution with HCl and then proceed with the arsenic determination as was done under Arsenic Solutions.

Note: Arsenic in brass solutions may be determined by taking 13.4 cc of the solution and following manipulations to this point.

2. **Determination of Copper.** Dissolve the precipitate that remained after dissolving out the arsenic precipitate with warm HNO_3 and wash filter out well. Boil to expel nitrous acid fumes and then proceed to determine the copper in the regular manner explained under Copper Solutions.

3. **Determination of Nickel.** The solution that remained after the precipitation with H_2S is boiled to expel the gas and then the nickel is determined as explained under Black Nickel Sulpho-Cyanate Solutions, and after that has been determined the same solution is used to determine the zinc.

4. **Determination of Zinc.** The solution in which the nickel has been determined is concentrated to 25 cc; HCl is added to decompose and bring into solution the cyanides. NH_4OH is added to make the solution alkaline, and then the nickel is removed as explained under Black Nickel Sulpho-Cyanate Solutions, and the zinc determined in the usual manner.

Brightener for Copper

Q.—Would you be kind enough to tell me in your next monthly issue what to use as a brightener for a still plating cyanide copper solution? I read an article some time ago in THE METAL INDUSTRY on what to use as a brightener for a barrel cyanide copper solution which was carbonate of lead mixed with strong caustic soda. This I found to be very good and the work came out of the barrel very bright. I tried some of it in my still tank but the work came out a very dark red, muddy color. I tried hyposulphite of soda and the work came out better, but after it was rinsed in cold water the work stained. The still cyanide copper solution is a large one of 700 gallons, used hot.

I would also like to know if a lead lined tank could be used for a cyanide copper solution.

A.—There are three principal brightening agents used for copper deposits from cyanide solutions. These are (1) lead in the form of oxide or carbonate dissolved in caustic soda or a caustic potash, (2) hyposulphite of soda. The latter acts as a triple factor; not only does it produce a brighter color to the copper deposit but it is also a reducing and conducting agent. Hyposulphite of soda is very largely used, but an excess should be avoided. Not more than 1/16 to ⅛ ozs. should be used per gallon of solution at any one time, to be repeated at intervals if necessary. However, in the production of oxidized copper finished the use of hyposulphite of soda is a frequent cause of trouble, especially if slightly in excess in the copper solution. The sulphur in the combination apparently deposits with the copper, and in such an event a gun metal finish is difficult to produce with the usual sulphur combinations used for oxidizing. The finish will be streaky brown or reddish when scratch brushed instead of a uniform blue black.

Lead in the form of carbonate or oxide does not always produce a bright copper deposit unless the copper solution is used hot and agitated. This refers to the still type of solution. Mechanical barrel copper solutions will plate bright if properly prepared without any brightening agent. The friction produced by rotation acts as a burnishing medium. However, any of the brightening agents mentioned may be used, but always in small proportions. It is an easy matter to add to a solution, but more difficult to remove an excess of material.

When articles are bright acid dipped after copper plating, lead is a help in the copper solution, for even though the copper deposit has a dullish red copper color it will come from the acid dip wonderfully bright. Many firms use the method to produce a bright finish upon copper-plated steel to eliminate buffing before nickel plating.

The staining of the copper deposit after lead had been added to the solution and finally hyposulphite of soda would indicate that some sulphur had been deposited with the copper. The addition of sodium cyanide slightly in excess of the usual amount of free cyanide used together with a small amount of bicarbonate of soda ¼ to ½ oz. per gallon of solution will overcome staining of the copper deposit as noted by you.

Lead-lined tanks should not be used for copper cyanide solutions. The caustic soda that develops from the decomposition of the sodium cyanide under electrolysis causes a reduction of the lead. When this becomes excessive the copper deposit becomes bright, hard and brittle, and finally a dark copper deposit results. Use steel, wood, or reinforced concrete tanks.—C. H. P.

AMERICANISM

Abstract of a Paper Delivered at the Foundrymen's Convention, Columbus, Oct. 4-8, 1920, by R. M. LITTLE, Safety Institute of America, New York

That all men are endowed with certain inalienable rights is the root idea of Americanism from the governmental point of view. The author states that Americanism is broad enough to include the values of all nationalities and it is not represented by any one race in the United States. The cry "America for Americans," is a provincial conception of Americanism; the country cannot be liberal, selfish or exclusive in its attitude toward foreign-born. Americanization means making good, loyal American citizens out of those who come to our shores. The first requisite in Americanization is that the citizens of the United States adopt an attitude of belief in the foreign-born. Laws and their administration should be adapted to the needs of foreign workingmen and these men should be taught civics so that they may understand our political methods. The churches should utilize their opportunity to help the people from other lands and where necessary, foreigners should have their own churches in order that they may have religious freedom. In industry, prejudice against the foreigner must be eliminated and he must be treated fairly. Foreigners deserve the interest and confidence of American citizens because their loyalty to the United States is fixed and lasting, as demonstrated during the late war.

Zinc Oxide Paint

Paint in which suitable proportions of Zinc Oxide are used covers more surface than lead alone, according to leading Paint technologists. Zinc Oxide also imparts toughness to the film, reduces chalking, gives the coating improved lustre preserves the oil and lessens the danger of fading.

Lead Plating From Sodium Hydroxide Lead Baths by the Use of Addition Agents

A Paper Presented at the Thirty-eighth General Meeting of the American Electrochemical Society, Held in Cleveland, September 30 to October 2, 1920

By FRANK C. MATHERS, Associate Professor of Chemistry, University of Indiana.

Abstract.

Many addition agents belonging to the class of organic fatty acids or substances such as gums and rosins containing similar acids were found to greatly lessen the formation of loosely adhering crystals on the lead deposits from baths of lead acetate dissolved in excess of sodium hydroxide. Probably gum sandarac and gum galbanum were best, but rosin and oleic acid were quite good. While the deposits were apparently non-crystalline, uniform and dense, corrosion tests in sulphuric acid showed that they offered less satisfactory protection to the metal beneath than lead deposits made in the fluosilicate bath.

INTRODUCTION

Many attempts have been made to plate lead from alkaline baths prepared by dissolving lead oxide or nitrate or acetate in excess of sodium hydroxide. Such baths have the advantage over the lead fluosilicate bath that they may be quickly prepared from materials that are easily obtained. However, the bath is a failure due to the very crystalline nature of the deposit. The directions for the operation of this bath[1] say that "in order to produce a dense deposit of some thickness, the objects have to be frequently scratch-brushed."

Apparently some attempts have been made to prevent the crystalline structure by the use of addition agents, as is shown by the sale of such a bath containing molasses, by a plating-supply company. This bath when tested in our laboratory did not give a satisfactory deposit.

The purpose of this research was to try various addition agents, in the hope that the alkaline lead bath could be made to give as satisfactory deposits as the acid lead baths.

APPARATUS AND METHODS OF TESTING

Baths of 200 cc. (0.4 pint) were used. The composition of the baths was 20 percent or grams per 100 cc. (26.7 oz. per gal.) of sodium hydroxide and 7.3 percent (9.7 oz. per gal.) of crystallized lead acetate. This quantity of lead acetate is equivalent to 4 percent (5.3 oz. per gal.) of lead. The temperature was 85° C (185° F.). The higher the temperature the better the deposits. Two lead anodes were suspended on opposite sides of the beaker by iron wires, and an iron cathode, freshly cleaned in acid, was suspended between the anodes. A current of 1.7 amp. per sq. dec. (15.8 amp. per sq. ft.) was used. The addition of more sodium acetate was found to have no influence upon the deposits, hence no effort was made to prepare baths without this by-product.

The selection of the above concentration was the result of a few preliminary experiments on variation in the concentration of the bath. Baths containing 1 and 2 percent of lead and 5, 10 and 20 percent sodium hydroxide gave brighter deposits the higher the percent of sodium hydroxide. A series of experiments using 20 percent sodium hydroxide and 1, 2, and 4 percent lead gave deposits that were less fluffy and more solid as the concentration of lead increased; then with 4 percent of lead and 15, 20, 30 and 40 percent of sodium hydroxide, the better deposits were obtained from the baths containing 15 or 20 percent sodium hydroxide.

[1] Langbein-Brannt, "Electrodeposition of Metals," p. 472.

EXPERIMENTS WITH ADDITION AGENTS

Most of the addition agents that were tried dissolved fairly well when added directly to the warm alkaline baths. In most cases, 0.5 percent (0.66 oz. per gal.) of the solid addition agent was added; increased quantities of the addition agents were tried but in general these increases produced no material improvement in the deposits.

The following substances produced no improvement in the deposits or at least very slight improvement when compared with the more effective substances: casein, cane molasses, phenol, tannic acid, gum arabic, clove oil, coal tar pitch, lanolin, stearic acid, aniline, nitrobenzene, water extract of pine wood, aloes from Barbadoes, brown sugar, creosote oil, tar oil, starch, gum mastic, eucalyptus, gum gambir, balsam tolu, Burgundy pitch, gum tragacanth, manna, gum guaiac, balsam copaiba, cottonseed oil, turpentine and thin tar oil.

The following inorganic substances showed no value as addition agents: sodium cyanide, sodium silicate, sodium aluminate, sodium thiosulphate ("hypo"), sodium sulphite, arsenious acid, and borax. Relatively large quantities of these substances, as high as 5 percent in some cases, were tried. The strong odor of ammonia from the bath containing sodium cyanide showed that the use of cyanide in these very hot alkaline baths was impossible even if a beneficial action had been observed.

Casein was decomposed by the hot alkaline liquid with evolution of ammonia. The cane molasses had some beneficial influence, as shown by the fact that the crystals were heavier and more firmly attached.

The following substances showed very marked beneficial influence upon the deposits: glue, oleic acid, whale oil, linseed oil, sweet almond oil, refined tar oil, sandarac, gum benzoin, Canada turpentine, gum rosin, euphorbia, gum galbanum, shellac, gum thus, gum ammoniac and asafetida. Of the above addition agents the sandarac, galbanum, euphorbia and rosin were perhaps the best. Probably others of the gums and rosins would have given good results if they had been tried. None of these addition agents dissolved completely in the alkaline baths. Even the soaps from the rosin and the oleic acid only partly dissolved. The limited solubility of some of the gums and oils may have been the only factor that caused them to give unsatisfactory results. This was undoubtedly true in the case of stearic acid. Some difficulty was caused by the insoluble matter, coming both from the impurities in the anodes and from the addition agent, making the cathodes rough. This trouble would not have been so great in cold baths but the high temperature kept the sludge thoroughly mixed throughout the baths.

The addition agents dissolved better in baths using potassium hydroxide in place of the sodium hydroxide, but the deposits were not sufficiently better to warrant the change.

Sandarac was probably the best addition agent, but good deposits can be obtained with rosin. About 0.3 to 0.5 percent of sandarac and 0.5 to 1 percent of rosin

should be used. It is best to dissolve the addition agents in dilute sodium hydroxide before putting them into the baths. A precipitate always forms, but if less addition agent is used in order to avoid this precipitate less good deposits are obtained.

TESTS OF LEAD-PLATED IRON IN SULPHURIC ACID

In all cases, iron objects plated in these baths were more readily attacked by 5 percent sulphuric acid than were similar objects plated in an acid lead bath. There seemed to be pin holes in the deposits through which the acid reached the iron.

CURRENT EFFICIENCIES AT THE CATHODE AND THE ANODE

A bath containing 4 percent lead, 20 percent sodium hydroxide and 0.5 percent of rosin gave a cathode efficiency of deposition of 99.6 percent and an anode efficiency of solution of 73.9 percent, with a current density of 1.75 amp. per sq. dec. (15.8 amp. per sq. ft.) at both electrodes. At room temperature, the anode efficiency was only 56 percent. With the anode surface increased so that the current density was 0.35 amp. per sq. dec., the anode efficiencies were 99.3 and 100.9 percent; at 0.5 amp. 99.6 and 99.3; at 0.7 amp., 99.4 and 101.4; at 1 amp., 99.4 and 99. These data show that the current density at the anode should not be greater than 1 amp. per sq. dec. (9.3 amp. per sq. ft.) and that the high temperature is necessary for proper anode corrosion as well as for improvement of the cathode deposit.

SUMMARY

1. Gum sandarac, gum, galbanum, rosin and oleic acid were satisfactory addition agents for restraining the crystalline structure of the cathode deposits in alkaline lead baths. Other gums, rosins and fatty acids showed marked beneficial influences.

2. A satisfactory concentration of bath is: 7.3 percent (9.7 oz. per gal.) of crystallized lead acetate, 20 percent (27 oz. per gal.) of sodium hydroxide and 0.3 to 1 percent (0.4 to 1.32 oz. per gal.) of addition agent such as gum sandarac, rosin, etc.

3. As high a temperature as possible should be used. Better deposits are obtained at 90° C. (194° F.) than at 80° C. (176° F.)

4. The current density at the anode should not be greater than 1 amp. per sq. dec. (9.7 amp. per sq. ft.) A cathode current density of 1.5 to 2 amp. per sq. dec. (14.1 to 18.8 amp. per sq. ft.) can be used, but the lower the current the better the deposit. At these current densities, the corrosion and deposition are approximately 100 percent.

5. The deposits are not as perfect as those from the acid lead baths, hence they are less satisfactory as protection against sulphuric acid.

6. Sludge in the baths at these high temperatures tends to cause roughness of the deposits.

7. This research is of importance in relation to the general subject of addition agents, in that it shows a class of addition agents that successfully overcome the crystalline structure in deposits from alkaline baths.

Bright Silver

Q.—Kindly inform me the proper method of operating a bright silver solution. The solution I have is of 200 gallons capacity and at times the work is very unsatisfactory. The class of work calls for a very durable plate which I have no trouble in getting, but at times the solution persists in running white, which takes on a poor finish when buffed.

Is benzol better than bi-sulphide of carbon as a brightener? What proportions should be used and how often should it be added?

What voltage and amperage should be used on above solution?

What causes the accumulation of rust on iron anode rods when silver solution is in use? Lack of cyanide or too much cyanide?

A.—The chalky tones of silver deposits usually develop from solutions made up from silver chloride and maintained with this material. The great silver plating industries in Connecticut do not use silver chloride in preparing their silver solutions or maintaining them in constant operation. They use silver cyanide with the correct proportions of sodium cyanide to give the double silver cyanide and sufficient sodium cyanide as free cyanide to give ample anode reduction.

The silver deposit comes from the silver solution after several hours plating with a semi-lustre termed by the platers a skim milk color. This surface polishes or burnishes readily and gives a bluish white color so much desired instead of the yellowish white color resulting from the constant use of silver chloride. As a rule such firms do not use a brightening agent, except on cheap work. Such work is usually only color buffed.

As a brightening agent one of the best materials to use is carbon bi-sulphide, especially when a solvent such as sulphuric ether is used. The addition of carbon bi-sulphide as brightener should never exceed one grain per gallon of solution at one time. This amount may be repeated according to the condition of the silver deposit. It is always advisable to add the brightening agent at the close of the day's work and stir the solution thoroughly, so that the next day the solution will work uniformly. The brightening agent should be prepared as follows, preferably as a stock solution.

No. 1—Bi-sulphide carbon, 2 ounces; sulphuric ether, 4 ounces. Mix together.

No. 2—Silver solution, 1 quart; sodium cyanide, 6 ounces. Mix together.

Mix No. 1 and No. 2 thoroughly by agitation. Keep in a glass bottle away from the light. The proportions given above will be ample for 1,000 gallons of silver solution, based upon nearly a grain of bi-sulphide of carbon per gallon of solution. However, use only half the amount to avoid an excess.

No. 2—Silver solutions containing an excess of chlorides as a rule have a greater reducing action upon the steel anode hooks than when such solutions contain very little. It is possible that the coating formed is a mixture of chloride and carbonate of iron. Many firms immerse their steel anode rods about four inches below the surface of the solution, and attach their anodes direct by bending over the rods. Anode hooks are thereby eliminated.

With a properly prepared and maintained silver solution the voltage need never exceed one volt, amperage in proportion to the surface being plated, and the amount of metal the solution holds. Too high a voltage will cause a dark film to develop upon the anodes usually attributed to the formation of a peroxide of silver which is only soluble when the solution contains an excess of free cyanide.

The rusting of the anode hooks is no indication whether the silver solution has an excess or lacks free cyanide. It is just a rust that develops from moisture. If you wish to avoid it, silver plate the hooks. C. H. P.

Faraday's Law at the Cathode

A Paper Presented at the Thirty-eighth General Meeting of the American Electrochemical Society Held in Cleveland, September 30 to October 2, 1920

By J. W. RICHARDS[1]

Careful consideration of the phenomena of electrolysis, particularly much experimental study of the relation of the anion and cation to the current passing, has raised in my mind the doubt as to whether the cation can be said to be directly amenable to Faraday's law. In other words, to put the question bluntly: Is the amount of cation liberated directly dependent upon a proportional amount of current passing, or is it secondarily or indirectly dependent thereon, being simply that amount of the cation which is chemically combined in the electrolyte with the amount of anion being liberated? In ordinary chemistry, in discussing various compounds of a metal with different quantities of an acid element, such as oxygen, chlorine, etc., we take it for granted that the acid element has constant valence while the valence of the metal varies in its different compounds. This is perhaps not a mere assumption, but is forced upon the theoretical chemist by many considerations, so many that it is at the present time taken for granted, as a matter of fact. This would point to the invariability of the valence of the anodic element and therefore of a constant relation between its quantity and the electric charge it carries; on the other hand, it would postulate a varying valence of the cathode element, that is to say a varying or indirect relation between the quantity of that element and the cathodic electric charge.

Whatever the real chemical reasons are, it is a matter of fact that the chemist speaks of stannous and stannic salts, mercurous and mercuric salts, cuprous and cupric salts, etc., etc., in all of which the invariability of the valence of the acid constituent is assumed and the variability of the valence of the basic element postulated. In electrolysis, the conventional direction of the current is from the anode to the cathode, but modern views incline to assuming the real direction of the current to be the opposite of this, viz that streams of so-called negative elections pass from the cathode to the anode. The existence of positive electrons, traveling in the opposite direction, is not established, and the tendency is to substitute for this conception the idea of a deficit of negative electrons, and thus complete a unitary theory of the electric current.

Since the acid element of a compound being electrolyzed is liberated at the anode, we can at once assume a direct relation between the amount of acid element set free and the quantity of negative electrons traveling towards the anode, in other words, that 96,500 coulombs, or one Faraday, accompanies one valence weight of acid element set free at the anode, or corresponds to one valence of chemical work done.

At the cathode, the amount of cathode element set free while one Faraday of electricity passes is a variable, according to the assumed variable valence of the cathodic element. It may be one Faraday is equivalent to a half, a third or a fourth of an atom weight, corresponding to the (assumed) chemical valency of the cathodic element.

It stands, therefore, as a matter of fact, and not at all a question of theory, that the relation between the current passing and the quantity of chemical element liberated at the anode is invariable and direct, while the relation between the electric current passing and the amount of cathodic element concerned is a variable, and therefore probably indirect.

The thesis which the writer wishes to bring forward for discussion is therefore the following:

Since the direct invariable relation between electrical current and chemical quantity subsists only at the anode, and the present theory of electric current postulates current passing, as negative electrons, only towards the anode, is it not logical and reasonable to assume that the direct relation between electrical current and chemi- and chemical quantity is true only at the anode?

On the other hand, the relation at the cathode being variable, and therefore probably indirect, is it not logical and reasonable to assume that this relation is not electrochemical but is more properly designated as chemical only; that is, it is governed by the chemical relation between the quantity of anodic element set free at the anode and the cathodic element. In other words, when the electric current sets free electrochemically at the anode a given amount of the anodic element or constituent of the compound, an amount directly determined by the electrochemical relations and Faraday's law, there is set free at the cathode that amount of the cathodic constituent which was chemically combined with the amount of anodic constituent liberated. This relation is chemical, and determined by the chemical equivalents of the substances in question, and subject to the variable valence of the cathodic element just as in any simple chemical decomposition.

If the above reasoning is valid and logical, it would follow that Faraday's law will apply fundamentally only to the anodic constituent, which is directly related to the quantity of negative electrons traveling to the anode; it would correspondingly follow that Faraday's law does not directly apply to cathodic constituents, but only indirectly through the chemical relation that the quantity of cathodic element liberated is simply that which was chemically combined with the quantity of anodic constituent liberated, and is only thus indirectly related to the quantity of electric current passing.

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SATIN FINISH ON BRASS

Q. Would you be kind enough to give me the method of refinishing Satin Finish Brass Beds?

The method I am now using, which is cutting them down and rubbing them down with emery cloth, does not seem satisfactory, as the finish is uneven.

A. Use the same grade of emery in powder, mix with oil and rub down your brass bedstead by the aid of cheese cloth or cotton waste. You will find this method will give you a more even surface upon the brass than when emery cloth is used.

Remove the excess of oil with benzine or gasoline. Wipe dry with cotton waste, cloth or tissue paper, and lacquer as usual.—C. H. P

Almost one-half of the compound of the best automobile tires on the market today is lead-free zinc oxide. This filler gives the tire its white color and resiliency and increases its tensile strength and durability.

The Operation of the Whitley Councils

Conclusion of an Article Giving in Condensed Form the History, Development and Present State of England's Experiment in Cooperation Between Employer and Employee*

There were in existence on January 1, 1919, twenty Joint Industrial Councils covering these industries:

Pottery, building, rubber manufacturing, gold and silver, match manufacturing, silk, furniture, heavy chemicals, bread baking (England), bread baking (Scotland), paint, color and varnish, vehicle building, China clay, hosiery (English), metallic bedsteads, bobbin and shuttle making, made-up leather goods, woolen and worsted (Scottish), hosiery (Scottish), and saw-milling.

The total number of workpeople engaged in those industries was estimated at about 1,500,000.

During last year the number of Councils established rose to 51, covering the following industries:

Wall-paper making, wool (and allied) textiles, tin mining, electrical contracting, packing case making, elastic webbing, Welsh plate and sheet, road transport, asbestos manufacturing, choir mat and matting, waterworks undertakings, local authorities' non-trading services (manual workers), gas undertakings, electricity supply, heating and domestic engineering, spelter, flour milling, boot and shoe manufacture, iron and steel wire manufacture, music trades, printing, needles, fish-hooks and fishing tackle, carpets, wrought hollow-ware, civil service (administrative and legal departments), electrical cable-making, tramways, quarrying, admiralty and cement.

This expansion during the year brought within the scope of the Whitley movement a further estimated total of workpeople of about 1,800,000. The number of workers affected by the operations of Joint Industrial Councils is therefore, to the end of last year, about 3,300,000.

In addition, Interim Industrial Reconstruction Committees (which are joint bodies similar in nature and functions to the Joint Industrial Councils) are in operation in the following 24 industries:

Brush making, patent fuel, gloves, glass, fertilizers, cutlery, furniture removing, safe, lock and latch manufacture, blacksmiths and farriers, basket-making, cooperage, cocoa, chocolate and food preserving, clay, railway carriage and wagon building, envelopes and manufactured stationery, lead, artificial stone, sugar refining, non-ferrous mines, paper-making, polish (boot and floor), gas mantles, optical instruments, and making-up and packing of textiles.

Works committees under the Whitley scheme (apart from many others formed under trade union and other auspices) have been set up or are being organized by the Joint Industrial Councils in the following industries: bobbins and shuttles, cement, China clay (pit committees) matches, music trades, pottery, printing, tramways and wool (and allied) textiles.

A substantial amount of practical work has been got through already by the Joint Industrial Councils. The settlement of wages and piece rates and arrangements for reducing the working hours of the week to 48 or 47 without reduction of wages has been the work of a great many of them. Several councils have devised machinery for dealing with disputes and for undertaking conciliation duties. In some cases arrangements have been made for such matters to be dealt with where possible by Shop or Works Committee or by District Councils, the National Council confining itself to questions affecting the whole industry. The Wool (and Allied) Textile Council has established an Arbitration Panel and a similar organization has been formed for the Chemical Trade, a committee having been appointed which is prepared to go at once to any place in which a dispute has arisen which cannot be settled locally. The Road Transport Council has appointed a Joint Traveling Arbitration Panel to compose all disputes which the District Councils cannot settle. The Furniture Trade Council has established a National Conciliation Board. Several councils are forming welfare committees with a view to improving factory conditions. Committees to deal with education and training of apprentices have been appointed by several councils and liaison officers have been appointed by the Board of Education to act in an advisory capacity on most of the Joint Industrial Councils. The councils in the building, pottery and vehicle building trades have appointed Statistical and Research Committees to consider such questions as scientific management and reduction of costs and problems of the industries.

Other organizations formed during the war have been working to promote a spirit of co-operation in industry. There is, for instance, the National Alliance of Employers and Employed, which was publicly inaugurated in Birmingham in January, 1917. It has held a number of imposing conferences at which labor leaders like Mr. Clynes, Mr. Hodge, Mr. Roberts and others have joined with large employers in urging the importance of common action for the common good and the necessity for increased production. There is also a body known as the Industrial League which is working on similar lines. Attempts have been made at a fusion of the two, but hitherto without success. In spite of the advocacy of eminent trade unionists, there is still amongst a large body of the workpeople a want of sympathy with such efforts. The spirit of suspicion is so inbred in the British workman that he is apt to see in every movement in which employers take part only another scheme for his exploitation. Governmental support of any movement in the present temper of the workmen, provokes distrust. There is also a considerable growth of syndicalism in some of the trade unions. But for these conditions the growth of the Whitley Councils might have been much more rapid.

At a recent meeting of the National Federation of General Workers in London the President, Mr. J. R. Clynes, M. P., said that there were in the labor movement people who did not favor any kind of coming together of employers and employed, but they were mostly people with no trade union work to do. He looked upon the headway made in regard to the Joint Industrial Councils as denoting a very remarkable advance in the sphere of industrial conciliation. He criticised, however, the tendency of these Joint Industrial Councils to become very costly machinery for trade unionists. He also thought that there had been a tendency among some employers to acquire for the Councils powers it was never intended they should have. The discussion that followed showed that the representatives were upon the whole favorable to the continuance of the Joint Industrial Councils, and that complaints were limited to a few particular Councils dealing with certain trades. A resolution was carried unanimously agreeing with the general principle of Whitley Councils but suggesting a joint conference of representatives of the affiliated unions together with delegates from the conference of Joint Industrial Councils for the purpose of devising ways and means for making these councils more useful to the workers concerned.

*The first two installments of this article appeared in THE METAL INDUSTRY for August and September, 1920.

EDITORIAL

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THE FOUNDRYMEN'S CONVENTON

The Columbus meeting of the American Foundrymen's Association, and the Institute of Metals Division, held at a time (October 4-11) when business was anything but encouraging, surpassed its previous high record of 1919 in Philadelphia. There were 240 exhibitors, over 4,200 registrations, and 70,000 feet of floor space. At the technical sessions 67 papers were presented, and at the non-ferrous sessions, several of the most interesting and practical papers that have ever been published were read. The foundrymen lived up to their promise of providing a strong technical program, and the meetings were live, well attended and filled to the last with warm discussions. The Institute of Metals also provided a number of interesting and worth-while papers, making the two joint sessions unusually strong. The individual session of the Institute of Metals Division, which was on general metallographic topics, also called forth an excellent response. Between the exhibition, the technical sessions, the banquet, the entertainment features and the plant visitations, nothing was left undone that the A. F. A. could do. There was, in many cases, much to be desired about the accommodations provided by the Columbus hotels, but this could not be properly charged to the managers of the convention. The 1920 convention and exhibit of the Foundrymen and the Institute of Metals Division was an unquestioned success.

FOUNDRY EQUIPMENT

In an interesting paper read at the Foundrymen's Convention in Columbus by Mr. H. R. Atwater, of Cleveland, an interesting view of the foundry equipment industry was shown. He recognized quite clearly the general tendencies of present day business. According to Mr. Atwater, "Work now being done in installing modern labor-saving equipment in foundries is only the start of a movement which is bound to expand in the next five years." His paper was intended for iron foundrymen, but the principle set forth applies well to metal foundries.

Wherever labor is cheap and plentiful, as it is in the backward countries, there is very small demand for machinery. Wherever labor is scarce and expensive, machinery is in strong demand. Judging by the last few years, the tendency of labor is decidedly upward in price, and this has manifested itself in foundries in no uncertain terms. Hence, labor saving and labor-eliminating equipment is eagerly sought.

The immediate situation or condition of business is not at all a permanent index, but merely a temporary condition. In the long run the future of the makers of improved machinery is very bright. Of course, improved

and sometimes complicated machinery must be handled fairly. Mr. Atwater's suggestion that foundries should be run as schools is a good one. With promotion from the ranks through the regular grades, there might be much less difficulty in maintaining and holding together a staff.

AMERICANISM

One of the best expositions of Americanism in its true sense (an abstract of which will be found on page 466 of this issue) was given by Mr. R. M. Little, of New York, at the Foundrymen's Convention. He made it clear that we must realize that the word American means any one who is a loyal citizen, regardless of where he was born. Only a part of our population is more than one generation from the foreign born. Without them America could never have been the America of today. The cry, "America for Americans," if strictly applied would force us to deport all except the descendants of the Indians, the New England Puritans, the New York Dutch, and the Southern Cavaliers. Those who are really against the Southern Europeans should read descriptions of the 1850's, when the Irish were condemned as "Micks" and Germans of the Carl Schurz type as "dirty Dutch."

The attitude to the foreign born should be one of friendliness not suspicion. Without toleration for assassins either of foreign or American birth, but with fair treatment before the law, education, decent wages, and housing conditions, in other words, human treatment, they could be made very quickly into good loyal Americans. Mr. Little's own words cover the situation as well as possible.

"If we expect to Americanize them we must believe in them. They believed in America and now it behooves those of us who make up the majority of the citizenship of America to believe in people of foreign birth. How can we do otherwise? Just at present it is not popular to champion their cause for the reason that the foreigner, so-called, is accused of a great deal of the public irritation and disturbance. No doubt they are unjustly accused in a great many cases. It is popular to make the foreign-born the scapegoat. But if we will carefully investigate the facts and analyze the conditions we will frequently find that it is not people of foreign birth and tongue so much as other forces which have raised the disturbance. Quite true, there are a few thousand agitators, radicals, revolutionists and bolsheviks who are attracting a great deal of attention and most of them merit the treatment they are receiving. But what are a few thousand in comparison to the nearly fifteen million law-abiding, industrious and loyal men and women from other lands who are in our midst? They are sharing our national life and doing much of our work, and in many respects they represent the youth, virility and strength of the countries from which they came. They came as vigorous young men and women to use their muscles and their brains in our industries, and while they are concerned for their own advancement, they make a contribution to our national life which is rich with the tradition of many centuries. They came not only to do our work, but also to help sing our songs, to write our literature, to please us with their music, their manners and their customs. They help to enrich our national life and we ought to believe in them and their possibilities. Americanism, first of all, means a certain attitude towards human life and there has not been anything in the past of these people of foreign birth to cause us to turn aside and say that they are unworthy of belief."

An interesting side-light on the type of the majority of those who are opposed to foreigners is the old story of the American born laborer of Irish descent, who was working alongside of an Indian on a railroad in Arizona. When the foreman asked him what he thought of his Indian co-worker, he answered, "Them foreigners ought to be run out of the country."

THE METAL BUSINESS

It seems to be generally admitted that prices are at last on the retrograde. Just how far they will go and how long they will take to get there is a matter for wide differences of opinion. So far as the buying public is concerned, that is, the retail buyers, who purchase for their personal consumption, the buying is only from hand to mouth. They will buy nothing that they do not absolutely need, and then only at a satisfactory price.

The first trades to feel this are, of course, the luxury trades. Leaving out of consideration for the time such things as textiles, furs, etc., which are not related to the metal field, the trade which has been hit hardest is the automobile business, which is one of the largest buyers and users of metals.

It is not entirely desirable that a luxury trade, important and widespread as it is, should form such a large part of the metal business. Temporary changes and fluctuations pay too large a part to be comfortable to those dependent upon it. Nevertheless, the condition obtains that the business is an enormous one; also that prices are being slashed and that in the very near future the public is looking for cuts in the prices of building trade materials, electrical materials, and household implements. The only question that remains is just where these cuts are to be placed.

In January, 1915, a period of extreme dullness, the price for copper was about 13½ cents, tin 33½ cents, lead 4 cents, zinc 6 cents, and aluminum 20 cents. At present copper is about 18 cents, tin 42½ cents, lead 7¼, zinc 7¾ cents, and aluminum 29 to 30 cents. Even to the layman it should be plain that there is no more difference in the prices of these metals than would be caused by the increase in cost of labor, machinery and freight. One is immediately forced to the conclusion that there is no room for a cut in the prices of raw materials. In copper and zinc at least, there has been little or no inflation. The large sudden drops in the prices of textiles, foodstuffs and luxuries betray the enormous profits made due to inflation, and not by large production. This, as shown by the comparisons of prices above, is not true of metal products. A similar comparison

between the steel prices of 1915, and the present, will show a much greater difference.

A part of the reason for this condition is the comparative absence or at least comparative weakness of the middlemen. The speculative market plays a very small part in the fixing of metal prices, with perhaps the exception of tin, which is largely controlled by the London market. Copper, zinc, lead and aluminum are controlled by the producers, who market the metal through their own selling agencies, and at the present time, at least, their prices are very close to rock-bottom.

The manufacturers of finished products who deal either directly or at second-hand with the public, will have to cut their prices, but they will be unable to pass more than a small proportion of this cut back to the foundries and mills who produce their castings and drawn shapes for them. The cuts must come largely where there is room for them. The basic metal trades, which include foundries and rolling mills, will probably have to swallow some reductions, and in the main will take them with good grace, in order to tide over an uncomfortable period and to keep their shops operating, but the major cuts must come where the profits have been out of proportion, and this is not in the basic metal trades.

The situation as a whole, as every one probably realizes, is uncomfortable, but not unhealthy. After a sufficient period of waiting, and when enough pressure has been applied, prices will reach their normal level, and buying will recommence. The consensus of opinion is that this change will take until Spring. In the meantime it is decidedly a buyer's market.

THE ASSISTANT FOREMAN PLATER

At the last annual meeting of the American Electroplater's Society, in Rochester, the most important and most hotly contested question brought to the attention of the society was that of the admission of assistant foremen to membership who had served five consecutive years. Those in favor of their admission gave the following reasons:

1.—The desire to help the men who are working with them and who are to follow them.

2.—It is narrow to bar men with five years' plating experience.

3.—The desire to train their assistants to keep up the standard of the department, and thus maintain their prestige.

4.—The object of the A. E. S. was progress,—not personal benefit, and the assistants would later help the Society fully as much as the Society had helped them.

5.—An auxiliary branch for the assistant platers would simply mean a divided house.

Those who were opposed advanced the following reasons:

1.—The A. E. S. was founded for foremen and should remain so.

2.—The Society would lose its standing if it admitted men who were not foremen.

3.—It would be best to help the assistant foremen organize an auxiliary branch or to let them form a society of their own.

Sooner or later, such questions have always come up in every technical organization. The great engineering societies have provided for this situation by admitting to associate membership those who have not had sufficient experience to qualify as full members. The associates are privileged to attend meetings and gain as much information and education as possible through contact with the more experienced and older men. This form of membership has been given even to college students with no experience whatsoever.

It is important for the present members of the A. E. S. to realize that one of the greatest dangers to a society is in-breeding, or becoming too exclusive. There are numberless organizations and associations of similar type that have made the mistake of making it too difficult to join them, and these associations have sooner or later gone to pieces. The society was not built for a day or week, nor was it organized for the benefit of those who happened to be members at the time. It was founded to advance the art of electroplating through the education of its members, and must last as long as electroplating as an industrial art exists. The only way to insure permanency is to provide for a new generation; new blood must be admitted or the society will decay.

A few rather enthusiastic believers in admitting assistant foremen have voiced the suspicion that the objections are caused by the fear of competition and replacement by the new men. We doubt greatly if any one with sufficient intelligence to do satisfactory work as a plating foreman would be foolish enough to entertain such fears. Such a person would fit much better in a home for the feeble-minded than at the head of a plating plant. To us it seems that the objections to the admission of assistant foremen to the society are based largely on pride in the organization, and a disinclination to lower its standards. Such pride is, of course, justifiable, but nevertheless in this particular case, mistakenly applied.

By all means, admit assistants to membership. It may be feasible to restrict them at first to associate membership, but after a suitable period, and with the recommendation of their foremen, there is no valid reason why they should not be admitted to all the privileges. The auxiliary society, if it could be started at all, would very soon prove to be a weak sister. Without the example and inspiration of the older and more experienced men such an organization would very soon find itself floundering helplessly. It behooves the A. E. S. to watch carefully lest it turn into a narrow, selfish body like the old type of unions which kept out the new men for fear of overcrowding the trade. By taking their assistants and helping them in every way possible, the society will find that it has gained prestige both throughout the plating trade in general and with their employers, since it will be evident that the men are making every effort to maintain the standards of their departments not only for the present but for the future.

TECHNICAL AND SCIENTIFIC PAPERS

THE ACTION ON ALUMINUM OF HARD INDUSTRIAL WATERS

Summary of Paper by Richard Seligman, Ph. Nat. D., Member, and Percy Williams, B. Sc., Member (London), presented at the Annual General Meeting of the Institute of Metals, held in London, on Thursday, March 11, 1920.

The authors first describe in detail the various forms of corrosion with aluminum exposed to the attack of hard industrial waters undergoes, and differentiate between superficial attack or "etching" and localized deep attack or "pitting."

They point out that while etching is of no practical importance, pitting is one of the great difficulties the aluminum industry has to contend with.

They discuss the various hypotheses extant by which the inception of corrosion is sought to be explained and show that these all entail the presence of oxygen. Experiments are described which show that in the absence of oxygen neither pitting nor etching occur even with sea-water. Other factors which might determine whether "etching" or "pitting" occurs are cited and discussed. These are "The Presence of Impurities," "Local Physical Differences in the Metal," "The Composition of the Water" and "Mechanical Imperfections in the Metal."

The authors conclude that the composition of the water and mechanical imperfections in the metal are responsible for pitting, which only occurs when the water contains simultaneously chlorides and bicarbonates. The roll of mechanical emperfections is to facilitate the retention of hydrogen peroxide which is produced during corrosion and which in its turn promotes corrosion.

In the second part of the paper a number of methods for preventing corrosion of aluminum by hard industrial waters are discussed.

A bibliography of papers dealing with the subject is appended.

IDIOMORPHIC CRYSTALS OF ELECTRO-DEPOSITED COPPER

Summary of Paper by W. E. Hughes, B. A., Member (London), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

Idiomorphic crystals of electro-deposited copper can be formed at will, if suitable conditions of deposition are adopted. It was found by the author that two requisites are (1) slow deposition of the metal, and (2) as little movement as may be in the solution. A suitable device was found to be—a small cylinder of metal, slightly hollow at one end, suspended *vertically* in the solution between two anodes. The solution consisted of copper sulphate and perchloric acid. Photo-micrographs of crystals of copper so formed are given in the paper. The conditions obtaining when the deposition proceeds under the circumstances stated are shown to be analogous to those in which good idiomorphic crystals are formed in salt solutions, as shown by Moore's experiments. And hence the author considers the formation of copper crystals and salt crystals to be governed by the same general laws of crystal formation.

The work of Sieverts and Wippelmann and of von Schwarz is considered in some detail.

THE POLISHING AND ETCHING OF ZINC FOR MICRO-EXAMINATION

Summary of Note by H. H. Hayes, Member (Birmingham), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

Owing to the rapid increase in the industrial use of zinc in the form of thin sheet, it has been found imperative to develop a rapid method of polishing and etching this material for microscopical examination in order to study the effects of different methods of annealing. In the method described by Mr. H. H. Hayes before the Institute of Metals the polishing is done with Globe polish on chamois leather. No water must touch the surface during or after polishing. The etching medium is fuming nitric acid, in which acid the specimen is immersed for one second and immediately rinsed in water and dried by a hot-air blast.

THE STUDY OF THERMAL ELECTRO MOTIVE FORCE AS AN AID TO THE INVESTIGATION OF THE CONSTITUTION OF ALLOY SYSTEMS

Summary of Paper by John L. Haughton, M. Sc., Member (Reddington), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

The constitution of alloy systems is generally investigated by means of thermal analysis and the microscopic examination of annealed and quenched specimens. Useful information can, however, be obtained by the study of the physical and mechanical properties of the series, and this paper deals with one of these, viz.: the study of thermal electromotive force.

The curves given, when the thermal electromotive forces of a series of alloys are plotted against the composition, are often very complex, but it can be shown that they are built up of branches which have one of three forms according to whether solid solutions or mechanical mixtures exist. The existence of compounds may be shown by breaks in the curves, or, in certain cases, by maxima or minima.

The arrangement of the constituents in an alloy may have an effect on the thermal E.M.F. The theory of this is worked out, and the results of experiments with composite copper and nickel rods are given. In this case the E.M.F. against iron is nearly 50 per cent. greater when the copper and nickel are in the form of small discs in series, than when they are in the form of a bundle of parallel sheets.

Practical details as to the methods employed in the determination of the E.M.F.'s for a series of alloys, together with a description of a simple apparatus designed for this determination, are given.

The paper concludes with an appendix describing the various thermal effects, dealing principally with the recently discovered Benedicks effects.

THE EFFECT OF PROGRESSIVE COLD DRAWING UPON SOME PHYSICAL PROPERTIES OF COMMERCIALLY PURE COPPER

Summary of Paper by W. E. Alkins, M. Sc., Student Member (Manchester), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

The object of the paper was to give a detailed account of the effect of progressive cold work upon the tensile strength, specific gravity, elongation, and scleroscope hardness of copper of the highest degree of purity commercially attainable, as it is drawn down into wire in the usual manner. It was found that each of these properties varied in an analogous fashion as the reduction in area increased; the tensile strength and scleroscope hardness increased, the specific gravity and elongation diminished, with increasing amounts of cold work. In every case the curve showing the variation in any given property with increasing reduction in area consisted of two branches connected by a short intermediate portion over which the change became very small over a limited range of reduction. With heavy instead of light drafting the break in the curves occurred at approximately the same percentage reduction in area, but when the metal was thoroughly annealed previously to the drawing the break set in at a somewhat earlier stage, and at a lower tensile strength. The agreement between the tensile strength and the elongation, and between the specific volume and the scleroscope hardness, was throughout very striking. No attempt was made at giving a theoretical interpretation of the results obtained. The paper concluded with a brief reference to several points of interest which had arisen during the progress of the work, and to methods for the more strictly quantitative investigation of the whole problem.

THE INFLUENCE OF COLD ROLLING ON THE PHYSICAL PROPERTIES OF COPPER

Summary of Paper by F. Johnson, M. Sc., Member (Birmingham), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

The paper deals with a further investigation of the changes in properties resulting from the uninterrupted cold-rolling of electrolytic wirebar copper, commencing with a thickness of 1.5 inches and finishing with a thickness of 0.033 inches, the number of passes being 17. The changes in tenacity, elongation, Shore and Brinell hardness, lateral spread and specific gravity were determined. By plotting these figures against percentage reduction of thickness, it was found that there were at least two well marked critical ranges of deformation, over which the tenacity, elongation and hardness remain constant, while the width of the strips also remains constant, no lateral spread being noticeable. There were marked indications of other critical ranges, also.

A few determinations of the elastic limits (or limits of proportionality) were made and they indicate a marked rise over the critical ranges. The specific gravity determinations yield no collateral evidence of the existence of the critical ranges, but concordant results were rarely obtained. By taking the tests always from the centre of the rolled strips more regularity was obtainable and an increase was observable which was steadily maintained up to 87 per cent. reduction. The author draws attention to the inequality of distribution of strains in the rolled strips both laterally, vertically and longitudinally.

Test pieces taken from the centre always yield the highest results for hardness and tenacity. Suggestions are made with a view to obviating experimental difficulties in future work. Micrographs of the series show a progressive flattening and thinning of the crystal grains until a typically laminated structure is obtained in which the grains appear as parallel laminae.

Some space is given to theoretical considerations and the author suggests that the crystal grains are forced by the rolling process into a homotropic arrangement in which slip can occur more smoothly and readily under tensional forces over the critical ranges than at other stages of deformation where tensional and compressional forces are both in action more or less equally.

TIN-PHOSPHORUS ALLOYS

Summary of Paper by A. C. Vivian, B. A., A. R. S. M., Member (London), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

Investigation of alloys obtained by the use of pressure tubes, examination of constitution, isolation of phosphides found and suggested temperature—concentration diagram up to 40 per cent. or 50 per cent. phosphorous contents.

(Work at Cambridge under C. T. Heycock, F. R. S.)

Ordinary phosphor-tin up to about 8 per cent. phosphorous is prepared at atmospheric pressure.

Under pressure in sealed vacuous hard glass tubes the alloys were made by putting the elements together in increasing proportions of phosphorus and heating slowly to 700° C., then cooling very slowly. Upon microscopic and microscopic examination of the series the following points were brought to light. Phosphorus and phosphides insoluble in solid tin:

Atmospheric pressure alloys (up to about 8 per cent. phosphorus) consist of solid solution (Alpha$_1$) of tin in the Alpha$_2$ phosphide Sn_4P_3 (16.4 per cent.) in a ground mass of pure tin—(maximum solid solution 14.7 per cent.). Pressure tube alloys—conjugate solutions appear (6 per cent. and 20 per cent.). Cooling conditions of perfect equilibrium between the conjugate solutions existing in this range would give (for average concentrations below 16.4 per cent.) Alpha$_1$ in a tin ground mass. Alpha$_2$ in Alpha Beta eutectic would be found with concentrations above 16.4 per cent.

Without stirring or seeding the freezing of these conjugate solutions exhibits a somewhat complicated series of happenings which are examined at some length with the aid of cooling curves taken from the alloys in the sealed tubes in an original manner.

About 20 per cent. Beta crystallizes from Beta eutectic up to Beta composition 25.8 per cent. Sn_4P_3.

Above this, Beta crystallizes from Beta-Gamma eutectic (Gamma = SnP_3 44 per cent. P.). 31 per cent. is Beta-Gamma eutectic.

Above Beta-Gamma eutectic another range of conjugate solutions occurs in the series of which the lower solution is Beta-Gamma eutectic and the higher appears when solid to consist of SnP_3 and fibrous red phosphorus very closely interwoven.

All the phosphides have been isolated chemically or mechanically.

SOME NOTES ON THE EFFECT OF HYDROGEN ON COPPER

Summary of Paper by W. C. Hothersall, M. Sc. Tech., and E. L. Rhead, M. Sc. Tech., Member (Manchester), presented at the Annual General Meeting of the Institute of Metals, held in London, on Friday, March 12, 1920.

That copper in common with other metals is capable of dissolving various gases has been common knowledge for many years, and some attention has been paid to the subject in regard to both the metal and its alloys. Chiefly, however, notice has been directed to the effects such dissolved gases have on the soundness and strength of castings.

The present paper by Messrs. W. C. Hothersall and I. L. Rhead relates to experiments on the effects produced on the metal by passing hydrogen through molten copper of differing degrees of purity varying from electrolytic copper to copper containing up to 0.4 per cent. arsenic and 0.4 per cent. sulphur.

They find that while sound castings cannot be obtained from copper melted under carbon and not otherwise treated, sound castings can be obtained from metal treated with hydrogen at or above 1,110° C. which has been allowed to solidify in the crucible after treatment and remelted.

Such copper retains much hydrogen. Analysis shows that the atomic amount of hydrogen retained is actually greater than that of other impurities, the effects of which are generally recognized.

Micrographs of the treated metal show that the effect of the hydrogen present is to cause the sulphide and arsenide contents to be completely segregated in envelopes surrounding the granules of copper, thus accounting for the increased electrical resistance which they found in hydrogenized copper.

THE ELECTRICAL PRODUCTION OF ALLOYS

Abstract of a paper presented at the Thirty-seventh General Meeting of the American Electrochemical Society, held in Boston, April 8-10, 1920.

By RALPH M. MAJOR.

Account of producing alloys in two Heroult furnaces having different electrode regulating equipment, and their effects on the working of the furnaces. Also a discussion of the general advantages of electric melting as compared with any other furnace. Detailed description of the manufacture and properties of nickel-chromium-iron (Nichrome) alloy, nickel-chromium (Kromore) alloy, nickel-manganese (Mangaloy) alloy, nickel-chromium-steel alloy, nickel-steel (Climax) alloy, and nickel-steel (Invar) alloy.

POWER PROBLEMS FROM THE STANDPOINT OF THE FURNACE OPERATOR

Abstract of a paper presented at the Thirty-Seventh General Meeting of the American Electrochemical Society, in Boston, April 8-10, 1920.

By WALLACE G. BERLIN.

A practical discussion of the nature of the power requirements when melting cold charges in the electric furnace. Different parts of the heat require differing amount of power, and produce different degrees of fluctuations of current. The effect of these on the power bill is considered, dividing the latter into "demand" power and "metered" power. The economics of running a large furnace slowly or a small furnace intensely is considered from these standpoints; also the question of running two furnaces in parallel so as to reduce the "demand' power, and of using off-peak power.

SHOP PROBLEMS

IN THIS DEPARTMENT WE ANSWER QUESTIONS RELATING TO SHOP PRACTICE

ASSOCIATE EDITORS { JESSE L. JONES, Metallurgical; WILLIAM J. REARDON, Foundry; PETER W. BLAIR, Mechanical; LOUIS J. KROM, Rolling Mill; CHARLES H. PROCTOR, Plating-Chemical; CORYDEN P. KARR, Exchange-Research

ALUMINUM CASTING

Q.—Please give me some information on aluminum casting.

A.—No. 1. There are many mixtures of aluminum, but the one most used for casting purposes consists of

92 ..... aluminum
8 ..... copper

This mixture is made as follows:

A rich alloy of 50 copper, 50 aluminum is first made by melting 50 pounds of copper in a crucible, and put the aluminum in a separate crucible or iron pot; pour the molten copper on the aluminum, stir well, pour into ingots, and use as follows:

Aluminum 84
Rich alloy 16

Flux with a small amount of zinc chloride.

No. 2. To prevent shrinkage use chills or as large risers as the patterns will permit on the heavy sections. The object of the chill is to set the heavy sections so that the castings are cooled more uniformly than otherwise, and prevent straining, which would fracture the casting. The large risers feed the shrinkage. Use your molding sand as dry as it will consistently hold together.

No. 3. There is no book published that I know of on this matter. I would suggest that you look over the back numbers of THE METAL INDUSTRY, where you will possibly get a great deal of information.—W. J. R. Problem 2,865.

ALUMINUM FOIL

Q.—I have a quantity of aluminum foil to melt and cast into ingots. Will you kindly advise me the proper way to melt this material with the least amount of loss?

A.—In regard to melting aluminum foil and casting into ingots, we would suggest the puddling process.

The melting can be done in an iron pot or crucible. If the iron pot is used, the empty pot is heated to a low red and shovel of the foil put in. The furnace tender should keep adding the foil and puddling. The metal is never allowed to get visibly red. When the pot is full add ¼ oz. of zinc chloride. Stir well and skim and pour in ingots. Your loss should not be over 3 per cent if the work is done properly.—W. J. R. Problem 2,866.

SOFT ALUMINUM MIXTURE

Q.—The writer is looking for a composition aluminum base that can be threaded—it cannot be too soft and not too hard. Pure aluminum, we understand, weighs 2.56 and phosphor bronze 9.2. If we could get up a mixture that would not weigh more than half the difference between these two, or weigh something like 4.5 to 5.5, it would answer. If you cannot give us this information, can you tell us of someone who can?

A.—For a composition aluminum base mixture that can be threaded, and not too soft and not too hard, and have a specific gravity something like 4.5 to 5.5. I would suggest the following mixture as being the most practical:

66⅔ ..... aluminum
33⅓ ..... zinc

This mixture will machine well and has a tensile strength per square inch of 30,000 lbs. A specific gravity of 3.50. The aluminum must be reasonably free from iron to get good results.

However, if a specific gravity of 4.50 is desired, a mixture of

55 ..... aluminum
45 ..... zinc

will give approx. 4.50 specific gravity, but is much harder to make satisfactory castings.—W. J. R. Problem 2,867.

BLACK ON BRASS

Q.—We would be glad to have you send us a formula for a black nickel solution for blacking chandelier parts that will relieve easily with powdered pumice.

We would be glad to have a formula to be used with and one without an electric current.

A.—Electric black.

Double Nickel Salts.....8 ozs.
Copper Sulphate .....¼ "
Zinc Sulphate .....½ "
Water .....1 gallon

Keep this solution near a neutral point with occasional additions of ammonia which tends to keep deposit soft. Use voltage of not more than 1. This solution can be used on solid brass or brass plated goods.

Dip black used on solid brass only.

Commercial Muriatic Acid.....1 gallon
White Arsenic .....1½ lbs.
Copper Sulphate .....4 ozs.

Bright dip the parts, rinse in cold water, then in hot water, then in black dip. Water must be kept out of dip if a good black is desired. Problem 2,868.

BRASS CASTING

Q.—We are experiencing some difficulty with castings for a small fire extinguisher. Our parties gave us an analysis of:

85.80 .....Copper
10.66 .....Zinc
3.22 .....Lead
.22 .....Tin

This casting has a lug on it about 2½ inches and leaks in this lug.

A.—This defect is caused by a draw or shrinkage. This mixture is not suitable for pressure work, and would suggest that you change the mixture to:

84 .....Copper
10 .....Zinc
3 .....Lead
3 .....Tin

or

83 .....Copper
4 .....Tin
8 .....Zinc
5 .....Lead

Put your runner gate in the cope side quite close to your casting, flux your metal with 1 oz. 15% phosphor copper, stir well, and you should have no further trouble.—W. J. R. Problem 2,869.

BRASS MELTING

Q.—Will you kindly answer the following questions? We are having trouble in melting brass and bronze in open flame furnaces, with oxide. Castings look good on the outside, but when turned up air cracks show and when broken up quite a lot of red oxide shows in the metal, especially around the risers.

We have one 1,000-lb. Monarch, one 500-lb. Monarch and one 1,000-lb. Lunkenheimer. On the 1,000-lb. Monarch we have 11 to 12 oz. air. On the Lunkenheimer about the same; on the 500-lb. furnace only from 10 to 11 oz. I think that is not enough air; we keep a correct record of the time melting, and take the temperature of every heat; we don't cast any brass or bronze over 2,100° F. or under 1,900° F. As near as I can judge we have a neutral flame, neither oxidizing nor smoky.

A.—It is quite natural that the metal around the risers of your castings should show up worse than any other part.

The risers are supposed to take up all the bad metal in casting. If, however, you have oxides it means that you are burning your metal. We would suggest that you run your oil flame so that it shows a little black. This can be done by using a trifle more oil than you have been accustomed to, and although it uses up oil, it keeps the atmosphere in the furnace reducing instead of oxidizing.

The different kinds of flames can be recognized very easily. An oxidizing flame is white and blinding in appearance. This should be avoided.

A reducing flame shows a small amount of black smoke.

Eleven to twelve ounces of air should be sufficient, provided you have forty to sixty pounds oil pressure.

An important point in addition to the pressure of air is the volume. Figure out the number of cubic feet so that you have about 2,000 cubic feet of free air per gallon of oil.—A. B. Problem 2,870.

COLORING BRASS AND BRONZE

Q.—As you are undoubtedly aware we are manufacturers of a spring type of snap fastener similar to samples inclosed. Note that this contains a phosphor bronze spring.

Up to this time we have been japanning this directly on the brass without any prior black dip. We find it would be much easier to japan these if they were first coated with a black finish or dip. We understand that other manufacturers are giving their fasteners some sort of a black dip. Can you supply us with the formula giving the materials necessary and their operations to produce a black finish on the brass but particularly on the phosphor bronze spring which we understand is most difficult to cover. Promptness in this matter will greatly oblige.

A.—Samples 1 were produced in the following solution.

Polysulphide .....2 ozs.
Liquid Ammonia .....2 fl. ozs.
Water .....1 gallon

Here the phosphor bronze spring is black, while the brass has a brown coloration.

Samples 2 were produced in

Hydrochloric acid .....1 gallon
Which is saturated with white arsenic.
Copper sulphate .....6 ozs.
Iron filings .....3 "

Here both springs and brass have a grayish black color.

Samples 3 were first dipped into the above polysulphide solution until springs were black; rinsed in water and then in the following solution used hot:

Lead acetate .....4 ozs.
Hyposulphite of Soda.....6 "

Here spring is black and brass blue.—J. H. Problem 2,871.

HARDENING NICKEL

Q.—Will you kindly let me know whether any experiments have been made (successful or otherwise) to harden pure nickel in some such manner as wrought iron and mild steel are hardened, i. e., by a carbonizing (cyanide, pack-hardening, etc.) or possibly by some other process that might be applied to pure nickel articles such as dies, etc.?

A.—Pure nickel is quite soft when annealed. A sheet about ¼" thick, thoroughly annealed, had a Brinell hardness of 38, which is about that of annealed copper. When case-hardened by the pack method, in pulverized bone, it had a Brinell hardness of 218, which increased to 247 after heating to 760° C. and quenching in water. This hardness, while a considerable increase over the original hardness, is still too soft for die or similar work. It is not better than cast iron.

J. O. Stead and A. A. Read, Inst. Mech. Eng., March, 1914, state that there appears not to be a nickel pearlite. The carbide (Ni_3C) always being in solid solution as nickel hardenite, is on rolling or annealing, due to its remarkably unstable character, broken up and practically all the carbon precipitated as graphite.

The same authors state that the compound Fe, Ni is remarkably hard and tough. A steel containing 13 per cent of nickel might therefore answer your purpose very well.—J. L. J. Problem 2,872.

INCREASING PLATING SPEED

Q.—Our business is mainly the copper plating of plaster of paris and in this connection, the writer is going to ask you a few questions and maybe you can be of some assistance to both him and our company.

First, after we have waxed and shellacked each piece which we are to plate, we spray them with a bronze powder and then strike the objects up at a volt and a half and then cut down the voltage to 4/5 of a volt. We then run the objects from forty-eight to sixty hours, and, in the writer's opinion, we could increase our production at least 25 per cent. if we could throw the metal on faster. Of course, this can be done if we increase the voltage but we find that if we increase it too much the copper deposited is pretty rough and, therefore, is not a good commercial article, especially as we polish these pieces after they are plated and then brass plate them and then finish them.

The writer further understands that it is possible to do this work and get the proper thickness of copper deposited by running at a higher voltage. He also might mention the fact that due to the deep recesses in our work it is necessary to take the objects from the tanks and retouch them with bronze powder again placing them in the tank for further plating.

A.—Your method of procedure is accurate in all respects except as to the voltage used. If you agitated your solution by air or agitated your cathode rods, you could use a voltage of 1½ to 2 volts, thereby doubling your amperage and turning out your work in one-half the time.—J. H. Problem 2,873.

PLATING BARRELS

Q.—How is the barrel in a barrel plating machine kept free of the metal being deposited?

How can I treat certain portions of a steel article so these portions will not take on any plate and not be affected by the solution, and said treatment not to increase perceptibly the size of the raw article?

If a cylindrical glass ring, which is a neat sliding fit, is slid continually along a rod being plated, what would be the effect, and would plating take place, and to what extent?

If the speed were increased in a conveyor plating tank, would the plating process be interfered with?

A.—In modern plating barrels the metal parts that are exposed to the action of the plating solution are reduced to a minimum. The negative contacts are all inside the revolving barrel, the external current being carried through a hollow shaft, properly insulated, to the conductors inside the barrel, which usually consists of copper strips run lengthwise, to a disc that is connected with the current carried through the shaft.

This or any similar method eliminates the use of metal on the outside of the revolving barrel, noted in many types of mechanical plating barrels on the market.

The only practical way to localize plating upon any metal is to use a stop off to protect the parts from the deposit. Asphaltum paint, when thinned down with gasoline or turpentine, may be used for the purpose. However, the coating should be thoroughly dry and hard before immersing the articles in the plating solution.

It is possible that the glass ring working to and fro over the metal rod being plated would act as a burnisher to some extent, producing a closer grained deposit. In the manufacture of seamless copper tubes by electrolysis, burnishing of the metal during deposition is accomplished in a similar manner with the aid of blood stone burnishers, moving to and fro over the entire length of the tube. The results are as noted. Presuming that the plating solution and current conditions were under proper control the motion of the glass ring should have but little action upon the deposited metal other than noted.

If the speed were increased to any great extent in a conveyor plating tank, above what we might term a normal rate, the rate of deposition of the metal would be decreased.

If, however, the metal content of the solution were increased, say to double the proportions and an equal increase in current was made, that is in amperes, then the speed o

the articles passing through a solution could be doubled, presuming that the highest point of efficiency has not already been reached in the solution being used.—C. H. P. Problem 2,873.

PLATING DIE CASTINGS

Q.—Please let me know the latest formulæ for plating white metal with nickel, copper or brass; also a solution for removing rust from brass.

A.—The following formulas can be used to advantage in plating white metal. We presume you refer to die castings:

Copper solution:

Water	1 gallon.
Sodium cyanide	3¼ ozs.
Copper cyanide	3 "
Bicarbonate soda	1 "
Hyposulphite of soda	1/16 "

Temperature normal to 120° Fahr. Voltage, 2½ to 3½.

Brass solution:

Water	1 gallon.
Sodium cyanide	4½ ozs.
Copper cyanide	3 "
Zinc cynaide	1 "
Bicarbonate soda	1 "
Sal Ammoniac 99% white	1 "

Temperature normal at 3 to 4 volts.

Nickel solution:

Double nickel salts	8 ozs.
Common table salts	4 "
Citric acid	¼ "

Anodes of the respective metals should be used. Solutions should be replenished from concentrated solutions of their original mixtures.—C. H. P. Problem 2,874.

SILVER SOLDER

Q.—I am having trouble brazing a brass ring ½" wide, ⅛" thick, 10" diameter, butt braze. I am using silver solder, but I have experienced great difficulty in making it hold, there being quite a strain on it.

A.—Silver solder is almost as strong as mild steel and it adheres well to brass when a borax flux is used, so no difficulty should be had in making a joint that will be stronger than the brass ring itself and of considerable ductility. It is necessary, however, to have the two ends of the ring held firmly together by means of clamps. In order to assure the flowing of the silver solder over the entire face of each cross-section of the ring, the following method may be used: Clamp the two ends of the ring together and drill a small radial hole through the joint. This will allow the solder to flow through and coat both faces of the ring, thus making a good job.—J. L. J. Problem 2,875.

SPOTTED NICKEL PLATE

Q.—We are having trouble plating some die castings and we are writing to you to find out if you can assist us in the matter.

It seems that there are black spots underneath the nickel plating that we put on and it will not buff off without cutting off the nickel plate.

A.—As you do not give the formula that you are using the cause of your trouble cannot be exactly stated. The black streaks are due to the reducing action that zinc has on the nickel solution causing nickel sulphide to be deposited, especially in cracks and crevices where current density is the weakest. The formation of black streaks is accelerated also by too great acidity or alkalinity and too low a voltage. The following solution will give results:

Single Salts	6 ozs.
Double Salts	2 ozs.
Sodium Citrate	3 ozs.
Sodium Chloride	2 ozs.
Water	1 gallon

Plate at 2½ volts; have current on as work is being in the solution. This solution plates rapidly. In 15 minutes work can be buffed.—J. H. Problem 2,876.

TO ACID NICKEL SOLUTION

Q.—I would be much obliged if you could give me some assistance with a plating problem on die castings.

For some months I have been running a nickel solution for zinc die castings with great success, the formula for which was as follows:

Double Salts	6 ozs.
Single Salts	3 "
Nickel Chloride	2 "
Boric Acid	1 "
Water	1 gallon

The work was given 1 hour in the bath and came out so bright that on some pieces we cut out the buffing. Now my plater got very ambitious and added a small quantity of citric acid. Consequently we lost our smooth finish also the lustre and have dark streaks.

Can I add anything to save the solution?

A.—Your plater has added an acid that is considerably a much stronger acid than boric acid, and has consequently brought about a condition that is favorable to the formation of black streaks on die-castings, namely, strong acidity. To save the solution neutralize the acid with carbonate of nickel which can be prepared by adding carbonate of soda (sal soda) to nickel sulphate. After allowing carbonate of nickel to settle wash several times with water. Then add this carbonate of nickel to your solution stirring thoroughly. Repeat stirring frequently so that action between acid and carbonate of nickel is thorough. If you can heat the nickel solution in any manner it would be the best procedure. When the nickel solution no longer turns blue litmus paper red, all the acid has been destroyed. Allow solution to settle, syphon off clear solution, clean out the tank and after replacing the solution, add your original 1 ounce boric acid per gallon.—J. H. Problem 2,877.

VERDE ANTIQUE FINISH

Q.—What is the formula for the Verde Antique Finish?

A.—

Copper Sulphate	4 ozs.
Zinc Chloride	1 "
Ammonium Chloride	2 "
Sodium Chloride	2 "
Acetic Acid	2 fluid ozs.
Water	1 gallon

Brush over articles and stipple nearly to dryness. Make as many applications as intensity of green is desired. When thoroughly dry spray lacquer.—J. H. Problem 2,878.

ZINC PLATING STEEL

Q.—Am sending you under separate cover a sample of an assembled sheet steel part which it is our intention to zinc plate for the purpose of putting on a cheap finish as regards appearance and also as a rust preventative until the item is put into use.

A.—The sample steel parts submitted to us can be successfully and uniformly plated in the proper type of zinc solution. Acid zinc solutions give good results upon articles that have no deep depressions. However, for your purpose we believe the alkaline solution would be more effective.

We suggest the following formula:

Water	1 gallon
Sodium cyanide	7 ounces
Zinc cyanide	8 ounces.
Caustic soda 76%	3 ounces
Soda ash 58%	2 ounces
Aluminum sulphate	½ ounce
Licorice powder	1/16 ounce

Use at a temperature of from 110 to 120° Fahr., at 3 to 4 volts and 20 amperes per square foot of surface. We would suggest that after zinc plating that the articles be washed in cold water, drained thoroughly and then immersed in a mixture of equal parts of paraffin wax and paraffin oil heated to 212° Fahr. The wax will coat over the zinc, eliminate any moisture and give an added protection against corrosion. Pure zinc anodes should be used and the solution should be replenished with a concentrated solution made up on the basis of the original formula. Problem 2,879.

PATENTS

A REVIEW OF CURRENT PATENTS OF INTEREST

1,337,585. April 20th, 1920. **Molding-Machine.** Elmer O. Beardsley, Chicago, and Walter F. Piper, Oak Park, Ill.

In a molding machine the combination of a projector for the mold-material, mechanism for driving the projector, means to movably support the projector and mechanism for automatically controlling the path of movement of the projector over a flask.

1,337,718. April 20th, 1920. **Cleaning of Ferrous and Non-ferrous Metals.** Sumner R. Mason, Wilmette, Ill., assignor to Western Electric Company, Inc., New York, N. Y.

An electrolyte for the cleansing of metals formed in the proportions of about 32 grams of cyanide to one liter of water, 4 grams of hydrate, and 8 grams of an organic agent.

1,337,780. April 20th, 1920. **Molding Machine.** John H. Lonskey, Detroit, Mich., assignor to Central Specialty Company, Detroit, Mich., a corporation of Michigan.

In a molding machine adapted for suspension from an overhead track on which the same is slidably movable, a gravity plunger for securing such machine to the floor and means provided for elevating such plunger therefrom, a tamping plate adapted to resist vertical pressure, a vertically movable cylinder fitted with a pattern plate, a molding flash adapted to be superimposed over said pattern plate and means for elevating said cylinder to compress the molding sand within said molding flask against the resistance of the tamping plate, and means for lowering said cylinder away from said tamping plate.

1,337,276. April 20th, 1920. **Electric-Resistance Alloy.** William A. Schench, New York, N. Y., assignor to Western Electric Company, a corporation of New York, N. Y.

An alloy containing nickel, 1½ per cent. cobalt or more and titanium, the nickel being in excess of 50 per cent.

1,337,464. April 20th, 1920. **Rolling-Mill Shearing and Piling Apparatus.** Henry G. O'Brien, Warren, Ohio.

The combination of a shear, a roll table at one side thereof the rolls of which are grooved in planes perpendicular to the roll axes, a gage adjacent to said table and movable to and from a position of obstructing the advance of a blank being conveyed by said table, the face of said gage being provided with projections adapted to fit into the grooves of said rolls when the gage is in the position of obstructing the advance of a blank, and means for moving said gage to said alternate positions.

1,338,517. April 27, 1920. **Alloy.** Foster Milliken, Lawrence, N. Y., assignor to Foster Milliken, S. Fullerton Weaver and James M. Repplier, trustees.

An alloy, consisting of the following ingredients in approximately the proportions stated, copper 50 to 60 per cent, nickel 26 to 34 per cent, iron 4 to 8 per cent, zinc 7 to 11 per cent, the said copper, nickel, iron and zinc being in a deoxidized state, and tungsten.

1,338,518. April 27, 1920. **Alloy.** Foster Milliken, Lawrence, N. Y., assignor to Foster Milliken, S. Fullerton Weaver and James M. Repplier, trustees.

An alloy consisting of the following ingredients in about the following proportions: copper 50 to 60 per cent, nickel 26 to 34 per cent, iron 4 to 8 per cent, zinc 7 to 11 per cent, the said copper, nickel, iron and zinc being in a deoxidized state, and chromium.

1,338,622. April 27, 1920. **Die Casting Machine.** Alfred Hakanson, Brooklyn, N. Y., assignor to Chatham Die Casting Company, Inc., New York, N. Y., a corporation of New York.

A die casting ladle including a web uniting the major extremity thereof with the doubled portion of the same, leaving the smaller nozzle extremity of said ladle free, and means connected exclusively to said web to determine the movements of said ladle.

1,338,631. April 27, 1920. **Electric Furnace.** Jonas Herlenius, Brooklyn, N. Y., assignor to Hamilton & Hansell, Inc., New York, N. Y., a corporation of New York.

An electric furnace having an apertured side wall, an electrode projecting with clearance through the aperture in the side wall into the furnace chamber, a pivotal support for said electrode exterior to the furnace shell, and a flat packing ring surrounding said electrode substantially in the plane of the pivotal axis of the electrode support to prevent leakage of air into the furnace chamber through the electrode opening in the side wall thereof.

1,338,762. May 4, 1920. **Electrical Welding Machine.** Edwin M. Bassler, Milwaukee, Wis.

In a welding machine of the type specified, the combination with the pressure lever thereof, of a weight applied thereto adapted for imparting movement thereto to subject the pieces to be welded to a desired welding pressure, means for retracting said pressure lever into inoperative position against the force of said weight, and means adapted for securing said pressure lever in inoperative position, substantially as described.

1,338,826. May 4, 1920. **Zinc Alloy.** Hans Goldschmidt and Karl Müller, Essen, Germany, assignors, by mesne assignments, to The Chemical Foundation, Inc., a corporation of Delaware.

An alloy containing zinc, and from about one-quarter of one (.25) per cent to about four (4) per cent of manganese, and at least six and nine-tenths (6.9) per cent of copper and aluminum together, the copper and aluminum being present in the ratio of about three parts of copper to about one part of aluminum.

1,338,966. May 4, 1920. **Manufacturing Solder.** Eugene Emil Pierre Jean Prudent Seville Jansen de St. Laurent, Twickenham, England, assignor to The Aluminum Solder Co., Limited, a company of Great Britain.

The method of making solder which consists in lining suitable crucibles with aluminum oxid and carbon, then melting separately in such crucibles zinc and tin, then pouring molten zinc from on crucible and molten tin from another crucible into a third crucible treated as above set forth, then stirring the mixture in said third crucible and then pouring the same into molds.

1,339,009. May 4, 1920. **Alloy.** George L. Van Allen, Prince Bay, N. Y., assignor to Baker & Co., Inc., a corporation of New Jersey.

An alloy containing 64 per cent of gold, 18¾ per cent of silver, 9 per cent of copper, 8 per cent of palladium and ¼ per cent of aluminum.

1,340,264. May 18, 1920. **Art of Tinning or Soldering Aluminum.** John Dean, Racine, Wis.

In the art of tinning of soldering aluminum, that step which consists in abrading the hot aluminum surface and applying the molten solder thereto by a mass of steel wool.

1,340,422. May 18, 1920. **Ingot-pouring Mechanism.** Samuel Bertram Sheldon, Duluth, Minn.

In a device of the class described, the combination of a movable carriage, a trough carried thereby and adapted to be positioned above a plurality of movable molds, said trough being provided with a plurality of discharge outlets so positioned as to register with the pouring opening of said molds, and means on said carriage for moving said trough to control the amount of metal discharged through each of said outlets, substantially as described.

1,340,437. May 18, 1920. **Metal Alloy.** George C. Deeter, Mechanicsburg, Pa.

A compound containing as its principal parts, metallic arsenic five per cent and lead ninety per cent.

1,340,451. May 18, 1920. **Alloy.** Theodor Koch, Newark, N. J., assignor to American Platinum Works, a corporation of New Jersey.

An alloy containing not less than 75 per cent of gold, ¼ to 5 per cent of manganese and 24¾ per cent to 3.3 per cent of nickel.

1,340,457. May 18, 1920. **Apparatus for Separating Magnetic Material.** Edmund Newton, Minneapolis, Minn.

A separator of magnetic material comprising a rotating receptacle, said receptacle being open at one end and partially open at the other end and being mounted so that during its rotation the bottom thereof shall continually slope upwardly toward the open end, means for feeding a mixture of magnetic and non-magnetic materials into the receptacle through the partially closed end, magnetic means for holding the magnetic material upon the lower portion of the receptacle, means within said receptacle and movable therewith for engaging said held material and forwarding it longitudinally of the receptacle up said inclined bottom and out of the open end thereof, and means for permitting the discharge of heavy non-magnetic particles from the lower end of said receptacle.

1,340,736. May 18, 1920. **Electric Soldering.** Harold K. Parsons and Harry H. Styll, Southbridge, Mass.

Electric soldering apparatus including a heating circuit, a progressive on and off switch for controlling the flow of current through said circuit, and means for automatically operating said switch.

1,341,291. May 25, 1920. **Hot Metal Car.** Carl P. Astrom, East Orange, N. J., assignor to M. H. Treadwell Company, New York, N. Y., a corporation of New York.

In a hot metal car, a tilting elongated car body having trunnions at its opposite ends and provided with a pouring spout located nearer to one end than to the other to thereby enable variable spacing between the pouring spouts by the placement of the cars in different end to end relation in a train.

1,341,337. May 25, 1920. **Method of Uniting Dissimilar Metals.** George A. Mead, Mansfield, Ohio, assignor to The Ohio Brass Company, Mansfield, Ohio, a corporation of New Jersey.

The method of uniting metals of unlike heat conductivity and different temperatures of fusion comprising the steps of holding the parts in contact at the desired point of union by pressing an electrode of high resistance against the part having the lowest melting point and greatest heat conductivity with a plate of metal interposed having a lower heat conductivity and a higher melting point than the aforesaid metal, then passing an electric current through the electrode and producing a high temperature therein which is transmitted to the metal parts to be united by conduction, said heat to be applied until the metals to be united are brought to a temperature at which they will unite.

1,341,647. June 1, 1920. **Electrode for Soldering and Depositing Metals by the Electric Arc.** Ernest Henry Jones, Islington, London, England.

Electrodes for soldering and depositing metals by the electric arc, comprising a metal wire, asbestos yarn wound upon said wire, and mechanical fastenings for the ends of the asbestos yarn, as set forth.

1,341,661. June 1, 1920. **Hardening and Annealing Furnace.** Alfred M. Moore, Malden, Mass., assignor to Alfred M. Moore and Chester M. Moore, Co-partners doing business as Moore & Co., Malden, Mass.

A hardening and annealing furnace comprising a movable hardening chamber, means for introducing heat therein, an annealing chamber, a movable carrier therein, a material tumbling annealing chamber, movable relative to the annealing chamber, a flue from the hardening chamber in heating relation to said annealing chambers, independent heating means for the annealing chambers, and means for agitating the tumbling annealing chamber.

1,341,670. June 1, 1920. **Casting Machine.** Ransom Judd Powell, Minneapolis, Minn.

In a machine for the casting of hollow objects, the combination of a revoluble member, a plurality of arms extending therefrom, a mold-carrying means rotatably mounted on each extending arm and means to engage each mold-carrying means to cause all molds to be rotated upon the revolution of said member.

1,341,686. June 1, 1920 . **Process of Extracting Platinum and Similar Metals from Their Sands and Ores.** Russell Thayer, Philadelphia, Pa.

The herein described process for the recovery of platinum and similar metals from granular ore, which consists in commingling with a charge of ore, a halogen compound of an alkali metal; subjecting the charge to the action of heat, whereby the metal is volatilized and removed from the ore; and collecting the volatilized metal, substantially as set forth.

1,341,682. June 1, 1920. **Method of Brazing End Rings.** Charles W. Starker, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania.

The method of manufacturing a dynamo-electric-machine rotor comprising brazing a member provided with an annular depression to a plurality of circumferentially arranged bars having their ends located in said depression which consists in placing a ring of solid fusible material adjacent to the edge, but outside, of the depression and applying heat to fuse said material and to cause it to flow into the depression.

1,341,774. June 1, 1920. **Metal Alloy.** Christian Bergh Backer, Montreal, Quebec, Canada.

An alloy consisting of not less than 85 per cent and not more than 98 per cent of magnesium, not less than 1½ per cent and not more than 14 per cent of aluminum and not less than ¾ of 1 per cent nor more than 6 per cent of zinc.

1,341,799. June 1, 1920. **Metal-Reducing Machine.** Bengt M. W. Hanson, Hartford, Conn., assignor to Pratt & Whitney Company, New York, N. Y., a corporation of New Jersey.

The combination of work holding means, tool holding means, and a pantographic carrier on which one of said holding means is mounted.

1,341,808. June 1, 1920. **Metal-Working Machine.** Otto H. de Lapotterie, New Brighton, Pa., assignor to Townsend Company, New Brighton, Pa.

In a machine for forming small articles from metal stock the combination of means for heating a small portion of the stock, means or severing the heated portion from the stock and pressure means for shaping the heated portion.

The method of making small articles from metal stock, which consists in heating a small portion of the stock, severing the heated portion from the stock and shaping it.

1,341,812. June 1, 1920. **Process for the Manufacture of Wires and Tubes of Two Metals.** Edouard Martin, Brussels, Belgium, assignor to Compagnie Belge Du Bi-Metal, Société Anonyme, Brussels, Belgium, a corporation of Belgium.

Process for the manufacture of wires and tubes of composite metal which consists in nesting a billet of steel into a jacket of the covering metal lined internally with a composite metal sheet adapted to form a brazing, welding the billet and jacket together by compression, and rolling and finishing the resulting blank.

1,341,839. June 1, 1920. **Flame-Welding Machine.** Worthy C. Bucknam, Jersey City, N. J., assignor to Davis-Bournonville Company, New York, N. Y., a corporation of New York.

In a machine for welding the seams of successive pieces,

the combination with a mechanically supported autogenous welding torch, of mechanism for successively positioning the pieces with the forward ends of their seams at the welding point, there causing them to rest for a definite period, and then longitudinally advancing them at welding speed.

1,341,840. June 1, 1920. **Autogenous Flame-Welding Machine.** Henry Cave, Hartford, Conn., and James L. Anderson, Bayonne, N. J., assignors to Davis-Bournonville Company, New York, a corporation of New York.

In a machine for welding by the autogenous flame process, the combination of a work-holder, means for delivering a welding flame of the character indicated upon the edges to be united, and mechanism for producing relative feed travel between the flame and work at a rate varying during the execution of the weld, for the purpose set forth.

In a machine for welding short tubular lengths, the combination with a stationarily supported welding torch, of a stationary jig comprising a block made in halves with a passage therein for the said articles and means for pressing the halves toward each other, and means for advancing the articles through the embrace of the passage in operative relation to the flame.

1,342,127. June 1, 1920. **Method of and Apparatus for Casting Hollow Bars or Tubes.** Grenville Mellen, Cranford, N. J.

The method of casting tubes which consists in locating a core within a mold chamber formed by a series of traveling co-operating mold-sections, and delivering molten metal into said chamber about said core during the movement of the mold section and the core located therein.

1,342,608. June 8, 1920. **Rolling Mill.** Lawrence C. Steele, Pittsburgh, Pa.

A rolling mill comprising roll housings having a vertically adjustable roll in the window thereof and a roll balancing mechanism having flexible members looped around said roll engaging with and yieldingly supporting the same within the windows of the housings.

1,342,636. June 8, 1920. **Electro-metallurgical Furnace.** Francois Louvrier, Paimboeuf, France.

An electro-metallurgical furnace comprising a reduction chamber, a feeding column leading thereto, an annular chamber surrounding said feeding column and leading to said reduction chamber, and means for supplying coal dust upon shelves into said annular chamber.

1,342,899. June 8, 1920. **Metal-Plating Machine.** Charles W. Eddy, East Providence, R. I.

In a metal coating machine, a pair of parallel shafts, a plurality of independent drums, and a pair of drive wheels fixed on each shaft for each drum for supporting and driving the same, the wheels supporting and driving one drum being of different diameter than the wheels supporting and driving an adjacent drum whereby one drum will be rotated at a different speed than the adjacent drum.

1,342,993. June 8, 1920. **Alloy.** Colin G. Fink, East Orange, N. J., assignor to General Electric Company, a corporation of New York.

A ductile alloy consisting mostly of nickel and containing at least 20 per cent cobalt and free from carbon, sulphur, phosphorus and basic impurities.

A wire for incandescent lamp and other uses, comprising by weight about 20 to 30 parts cobalt, about 80 to 70 parts nickel and several parts of manganese.

A ductile alloy for supports for incandescent filaments and other uses, comprising by weight about 20 to 30 parts cobalt, about 80 to 70 parts nickel and 2 parts manganese.

A ductile alloy consisting mostly of nickel and containing at least 20 per cent cobalt with a small proportion of manganese and free from basic elements and from carbon, sulphur and phosphorus.

1,343,016. June 8, 1920. **Casting Apparatus.** Francis H. Vallender, Arlington, Mass.

A casting apparatus comprising a supporting structure, including an air pump cylinder, and a flask seat on one end of the cylinder, said head and seat having an air duct constituting the air intake of the cylinder, a carrier movable relatively to said structure, a piston and a platen connected with said carrier and movable in unison thereby, said piston being adapted to exhaust air into the cylinder from an investment in a mold flask supported by said seat, and the platen being adapted to exert downward pressure on said investment, and means for moving said carrier to simultaneously move the platen and the piston.

1,343,017. June 8, 1920. **Process of Casting.** Joseph L. Ware, Minneapolis, Minn.

The process of manufacturing metal articles having relatively movable parts which consists in forming a mold of the article by means of a pattern, removing said pattern, wrapping with sheet asbestos a member which is to form part of the article, securing the sheet asbestos in place upon this member, placing said covered member in the mold and filling the remaining portion of the same with molten metal.

1,343,842. June 15, 1920. **Process and Apparatus for Metal-Plating.** Robert J. Piersol, Bentleyville, Pa.

A process for the plating of one metal by another metal which consists in treating one of said metals with the other of said metals in vacuo at a temperature between the melting points of the two metals.

1,343,843. June 15, 1920. **Galvanizing Furnace.** Carl A. Porath, Kokomo, Ind.

In a galvanizing furnace, a tank for containing galvanizing material, a substance of greater specific gravity than the galvanizing material in and covering the bottom of said tank, and means located under said tank for heating the bottom thereof.

1,344,566. June 22, 1920. **Solder for Aluminum.** Julian Segura, New York, N. Y. Filed May 18, 1920. Serial No. 382,358. 2 Claims. (Cl. 75-1.)

A solder for aluminum consisting of 49 parts of zinc; 40 parts of tin; 10 parts of lead, and 1 part of white metal (the composition of the white metal ranging from 80 to 90% tin, 5 to 15% antimony, and 3 to 10% copper).

1,344,690. June 29, 1920. **Preheating Furnace for Welding Castings.** Arthur E. Hauck, New York, N. Y.

A furnace provided with flame chambers, top fire bricks with perforations over said chambers and division plates adapted to receive and support a casting surrounding said top fire bricks.

1,344,960. June 29, 1920. **Implement for Smoothing Metal.** Ernest G. Raff, St. Louis, Mo., assignor to Stiles-Gilliland Manufacturing Company, St. Louis, Mo., a corporation of Missouri.

An implement for smoothing sheet metal comprising a threaded collar, a screw working in said collar, a follower-arm arranged crosswise of said screw and having a swivel connection with one end thereof and said screw having a handle at its other end said follower-arm having slots in its opposite ends arranged parallel with the longitudinal axis of said screw, spaced rollers in said slots and lever arms arranged parallel with said screw on opposite sides thereof, said lever arms being inclined toward each other at one end and pivotally connected to said threaded collar, having alined sockets in the other ends, tools removably mounted in said sockets, said tools comprising yokes having rollers journaled therein, said rollers being positioned on the inside of said arms and arranged with their axes parallel, the inclined portion of said lever arms extending through the slots in said follower-arm and being arranged between the spaced rollers thereof whereby actuation of said screw causes the rollers to engage the inclined portions of said lever-arms to open and close the same.

EQUIPMENT

NEW AND USEFUL DEVICES, MACHINERY AND SUPPLIES OF INTEREST

EXHIBITS AT THE FOUNDRYMEN'S CONVENTION, COLUMBUS, OCT. 4-8, 1920

NEW LA FRANCE LANTERN

The new La France lantern No. 1810 will, it is claimed, appeal to all those who have to carry a light. This lantern is waterproof, and is absolutely safe to use around inflammable material of any kind. It is an ideal light for watchmen, firemen, sportsmen, or automobilists. All metal parts are of brass and aluminum, accurately machined and nicely finished. The silvered reflector is large and designed to throw a wide working light with a strong, far reaching beam for smoke, fog, or long distance work. A focussing device permits of changing the beam while the light is burning.

The light is controlled by a strong spring snap switch, conveniently located and positively spark proof. The current is supplied by two standard dry cells, obtainable anywhere. This lantern will give months of intermittent service. The finish is regularily in red with black and polished brass trim, but furnished in other colors or polished aluminum if desired. A bracket for mounting is furnished at a slight extra cost. A plain bracket for the wall, truck or boat, and a special heavy brass bracket with a spring lock for fire apparatus. The price of the lantern complete with two cells is $14.50. Manufactured by the American-LaFrance Fire Engine Company, Elmira, N. Y.

AJAX CORE BINDER

Ajax core binder is a light material weighing six pounds to the gallon. It will not harden in the sacks.

The important qualities claimed are as follows:

(1) Extremely quick burning in the hot casting—giving a very collapsible core, even for lightest castings.

(2) Green bond and body for prevention of sagging and green core breakage on "stand-up" work. This body is combined with the greatest openness.

(3) Ajax assists greatly in securing a good peel from the casting, smoothness of cores and clean drawing from boxes.

(4) Uniform mixing and great spreading qualities, even in smallest proportions.

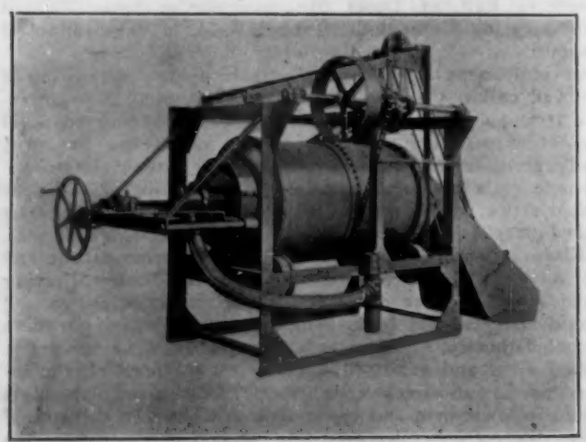
(5) Moisture resistance as compared to dextrine and similar materials.

(6) Quick drying.

Ajax core binder is manufactured by American Hominy Company, Indianapolis, Ind.

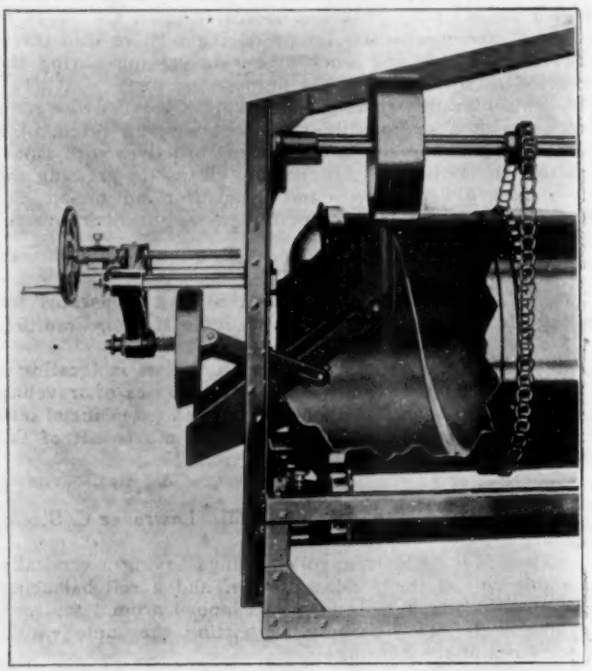
NEW AUTOMATIC TUMBLING BARREL

The Ideal Automatic Patented Tumbling Barrels have the action of ordinary barrels except that they are said to tumble much faster. They load automatically from ground level, and discharge the work directly into buckets or buggies without stopping the barrel. It is claimed, that each Ideal Barrel in service is doing as much work as four or five regular mills, and with a saving in labor of at least 60 to 75 per cent.



VIEW SHOWING COMPLETE BARREL

This is not continuous tumbling. The work is held in the drum as long as desired, and the operator can reach in and take out a sample of the work at any time while the work is tumbling. This prevents over tumbling, or not tumbling enough. The barrels are built either for exhaust tumbling, or wet tumbling, and can also be equipped with slots for the separation of trimmings.



VIEW OF AUTOMATIC DISCHARGE

Where an exhaust barrel is desired, the exhaust is taken care of by the hollow trunnion in the discharge plug, and the flexible steel tubing shown in above cut. The barrels can also be adapted to wet tumbling.

They are manufactured by the Ideal Concrete Machinery Company, Cincinnati, O.

NEW CORE OVEN HEATER

This heater, manufactured by the Hauck Manufacturing Company, Brooklyn, N. Y., is designed to burn gas, crude oil, fuel oil or kerosene. As can be seen from the illustration, the flame enters at one end. It is extinguished just as it enters the main distributing pipe; the gases emerge through the perforations in the large pipe (with the other end blanked), and a flame appears at each perforation.

CORE OVEN HEATER

NEW CRUCIBLE FURNACE.

This furnace, operated with a compressed air burner (40 lbs. pressure), will burn fuel oil, crude oil or kerosene, and melt brass, aluminum, steel or iron. An auxiliary air open-

ing sucks 75% of the total air used as free air, only 25% of the total air being supplied by the compressor. The oil is siphoned into the burner by the high pressure air.

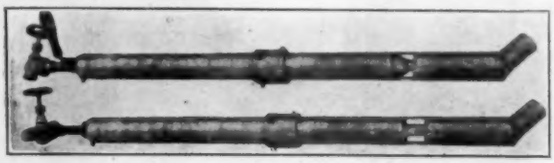
In a test run by the manufacturers, 70 lbs. of brass scrap were melted in 35 minutes for the first heat, and in 22 minutes for the second. The oil consumption is 3 gallons per hour.

The furnace is made by the Hauck Manufacturing Company, Brooklyn, N. Y.

NEW OIL FURNACE

A metal melting furnace has been placed on the market by the Caward-Gaskill Furnace Corporation, Monadnock Building, Chicago, Ill. It is oil burning, of the pre-heated air type, oscillating and with new and peculiar characteristics. The burner, it is claimed, plays a vital part in the high efficiency and speed of Caward-Gaskill furnaces.

As will be seen by the cut, the hot air from the pre-heat chamber of the furnace passes through the large steel tube



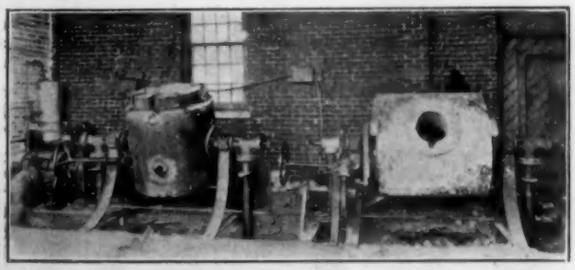
UPPER CUT OF BURNER SHOWS CONICAL VALVE IN NEARLY-CLOSED POSITION
LOWER CUT SHOWS VALVE DRAWN BACK TO FULL OPENING

of this burner under pressure. A cone device in connection with the control rod opens and closes the outlet, so that volume of air can be controlled by the furnace operator, anywhere from full-volume down to a complete shut-off.

Inside the large air tube is a small oil line with needle valve control, the hot air raising the temperature of the oil to about 800 degrees F.

The hot oil is forced, under 45 to 50 lbs. pressure, through a small bore passage, the diameter of a pin, in the bronze nozzle into the mixing chamber in the elbow of the air nozzle. Here the tiny stream of hot oil is caught in the swirling vortex of the hot air that rushes through the annular passage between the oil pipe and the steel air line. The result is claimed to be a hot, highly inflammable air-and-oil gaseous mixture which gives complete combustion in the furnace, even when low-grade fuel is used.

Cold air from the blower is forced under 1½ to 2 lbs. pressure into the annular chamber between outer and inner steel walls. Radiation from the fire brick lining, through the inner



ONE ¼ TON OSCILLATING TYPE AND ONE NO. 150 CRUCIBLE TILTING FURNACE. ILLINOIS PATTERN AND FOUNDRY COMPANY, CHICAGO, ILL.

steel wall, heats this air to about 800 degrees F. before it enters the combustion chamber of the furnace through the burners.

The tests of the manufacturers show the following:

Starting with a cold furnace, we have made a melt of brass in 45 minutes; subsequent melts, with hot furnace, in 20 to 30 minutes.

In melting yellow brass, their tests have shown that metal loss averaged below 2%. Loss on red brass is practically nil. Brass chips (borings, turnings and other finely divided waste) are melted successfully without briquetting, and with minimum volatilization loss, as the heat is applied indirectly through the white-hot fire brick lining.

Their own unofficial tests have indicated that Caward-Gaskill furnaces have a remarkable fuel efficiency. On continuous runs of brass they have averaged less than ½ gallon of oil per cwt. of metal poured.

These furnaces can use heavy low grade fuel oil, because of the pre-heating of the oil in the burner line.

These furnaces are equally adapted to handling aluminum, white brass and various non-ferrous alloys, as well as steel.

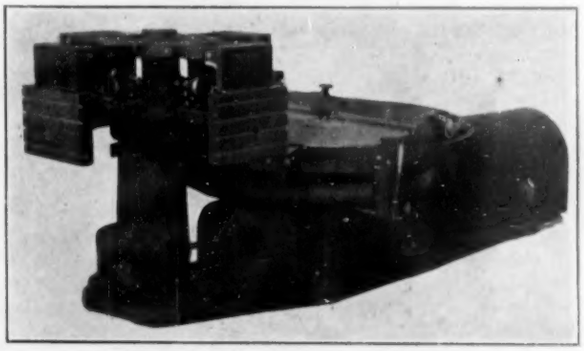
NEW PRE-HEATED AIR FURNACE

The Monarch Engineering and Manufacturing Company, Baltimore, Md., has placed on the market a new open-flame melting furnace with an annular chamber through which the air travels before reaching the burner. This pre-heats the air, making use of the heat formerly lost through the shell, reducing oil consumption.

The same company has also developed a larger size of its rotating brass furnace, making it considerably narrower and longer. This brings the flame much closer to the metal and decreases the oil consumption and time of melting.

NEW HIGH PRODUCTION GRINDER

The No. 24 Continuous Feed Disc Grinder for quantity production is manufactured by the Gardner Machine Company, Beloit, Wis. It consists of a horizontal disc, about 5 feet in diameter, with the work carried over it by a work reel.



HIGH PRODUCTION DISC GRINDER

The man in attendance simply loads and unloads the pieces to be ground. The grindings are thrown by centrifugal force to a peripheral case which is connected to an expanded fan, and are drawn into a discharge bin.

The work reel has four fixtures for the work which are adjustable for height, giving any size cut desired. Different types of work will, of course, call for different fixtures.

The horizontal disc is of steel, covered with the GIA abrasive disc, a very heavy coating of abrasive on cloth, which, it is claimed, by virtue of a special bond, does 6 to 10 times as much work as the common glue-bond abrasive. On a job of grinding cylinder heads for gasoline engines, 9 inches in diameter, the machine takes off ⅛ inch of stock at the rate of 2 per minute.

The abrasive can be trued up by means of a dressing attachment on a horizontal bar across the top; the dresser can be run back and forth diametrically across the wheel, on the bar.

Any angle desired can be obtained between the ground surface and others on the article to be ground.

REPELLING ARC ELECTRIC FURNACE

This type of electric melting and refining furnace operates directly on 220 volt motor circuits without transformers. The arcs are drawn, sustained and regulated by a balancing system that, it is claimed, automatically gives stability and requires no electrical knowledge on the part of the operator.

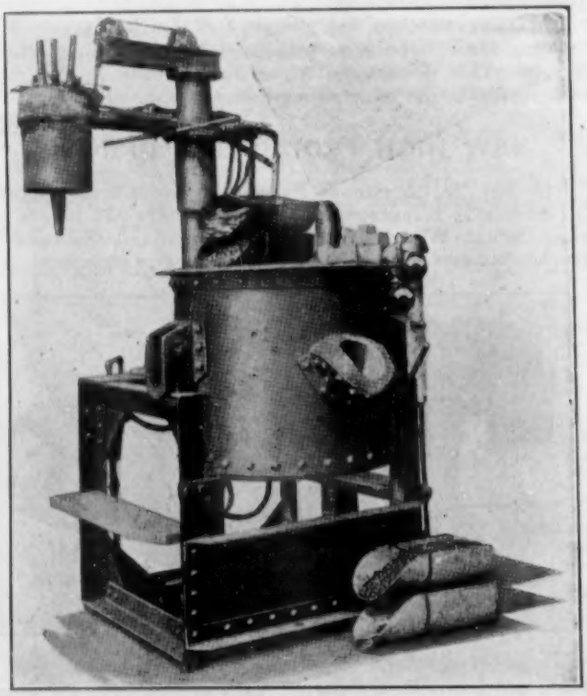
It is built in sizes from 300 pounds per heat up to one and one-half tons.

The furnace consists in general of a refractory lined shell or furnace body, through the roof of which is suspended a heating element which can best be described as an electric arc torch. This torch diffuses a flame inside the furnace body.

The shell is cylindrical in shape and is made of extra heavy steel plate. This shell is mounted on a portable steel frame which makes special concrete foundations unnecessary. A heavy rocker trunnion is mounted on each side of the shell and supports the shell on the frame, allowing it to lock after pouring. The furnace is tilted by hand—all mechanical tilting equipment has been eliminated.

When desired, the furnace shell containing the molten metal can be lifted from the frame by a crane and conveyed to molds where pouring can be done direct from the furnace without the use of a ladle.

This furnace is built in single phase, three phase, or direct



FURNACE WITH ELECTRODES OUT READY FOR CHARGING

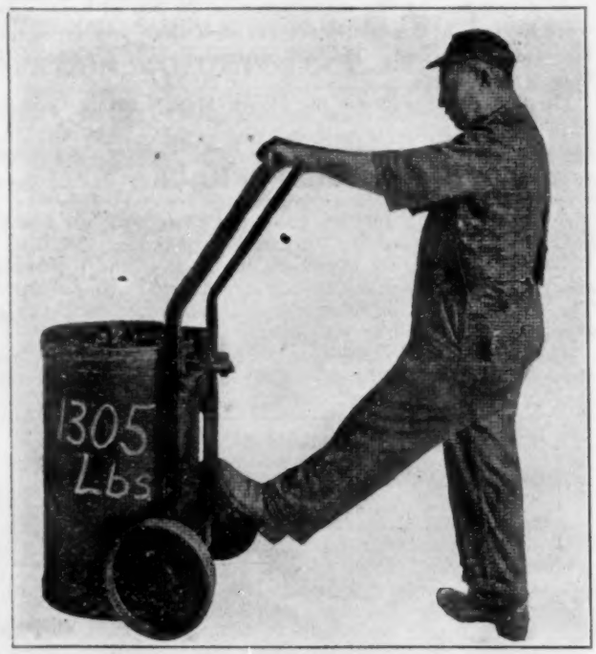
current types. With single phase or direct current two electrodes are used, and with three phase three electrodes. These electrodes are held in place by a refractory sleeve which is so mounted that sleeve and electrodes can be raised or lowered in or out of the furnace, or can be swung aside to permit charging through the opening in the top of the furnace. After the furnace has been charged electrodes and sleeve can be swung back to center of furnace and lowered within a few inches of the charge. Then the electric power is again applied and the arc put in operation. This arrangement does away with all side doors.

The furnace is the invention of A. Von Schlegell, and is manufactured by the Industrial Electric Furnace Company, Chicago, Ill.

NEW BARREL HANDLER

Steel barrels are often indispensable for handling small parts in foundries, machine shops, stamping works, stock rooms and assembly floors.

The Sabin truck, it is claimed, eliminates the necessity of the trucker having these helpers, even with the heaviest loads. It lifts from the upper portion of the barrel which does away with the necessity of tipping the barrel to insert the nose of the ordinary truck under it. The barrel is automatically clamped in place and the truck itself acts as a lever in lifting the load.



HOW ONE MAN HANDLES A BARREL

The advantages claimed are:

Any steel barrel can be used without trunnions or raised center bottom.

Barrel can be picked up from any side.

Barrels can be stored without space between.

The truck can be used in close quarters and with narrow aisles. It is only two inches wider than the barrel.

Barrel can be filled and the pieces will not spill. Load balances by tipping the barrel but a few degrees.

Load can be lifted with one-quarter the effort expended with an ordinary truck.

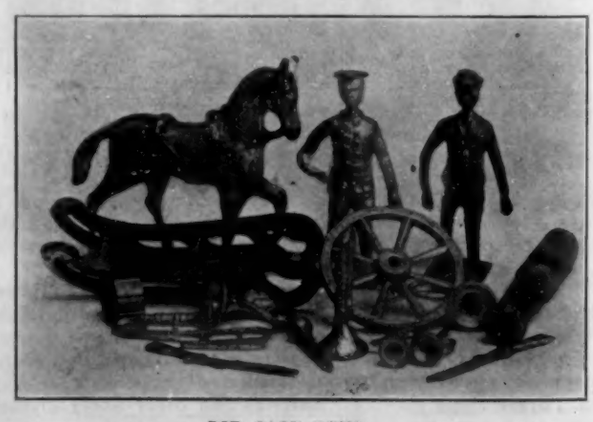
Load rolls on Hyatt roller bearings.

Wooden barrels can also be handled easily.

These trucks are used by such concerns as The Cleveland Tractor Company, The National Malleable Casting Company, The Perfection Heater Company, The Oster Manufacturing Company, The Ohio Foundry Company and many others. They are manufactured by The Sabin Machine Company, Cleveland, O.

A NEW DIE CASTING MACHINE

This machine was built especially for small work such as metal toys and nicknacks. It is claimed that any person can learn how to operate this machine within five minutes



DIE CAST TOYS

and cast with one die from six to ten thousand pieces per day.

The control lever is operated with the right hand and connected with a small pinion which drives a rack connected to the overhanging bracket. This bracket is again connected to the piston in the cylinder which is at the bottom of the melting pot in order to prevent any foreign metal or dirt to pass into the cylinders. The metal is heated by gas and air which pass through an opening into the cylinder. The piston then presses the metal into the forming dies. The die is located in an enclosed box which is fastened at the top of the base. This box has hinges on the front so that it can be tipped over to prevent the metal from clogging the nozzle. The back end of this box is fastened by two eccentric clamps. This is designed so as to bring the die box over the nozzle, which is ball shaped, and make it positive to locate in the proper position after the clamps have been drawn up in order that the metal can easily flow into the die. Instantly after the metal is in the die, the die is brought forward by the special designed levers which perform this operation. This forward action will cut off the gate from the casting and permit the gate to fall back through the tapered nozzle into the hot metal. The forward action of this die continues until the rear half reaches the adjustable stop. The front half still moves forward until it reaches another adjustable stop whereby the knock-outs are set in such a position as to remove the casting from the die. The casting will fall through an opening into a box standing below the machine, then the control lever is brought back by the right hand and the die comes back into position ready for the next operation. The operation can be repeated every three seconds if the die is properly cooled. The same can be done with larger and more complicated castings, providing the machine is built larger. The expansion of the die by the heat is regulated by springs in the die box in order to prevent the die from sticking to the box in which it moves.

This machine is covered by patents and owned by U. S. Art Metal Toy Company, 1001 Sixth street, Milwaukee, Wis. They are ready to sell their patent, reserving only the right to use the machine for their own manufacturing purposes.

NEW POLISHING WHEEL

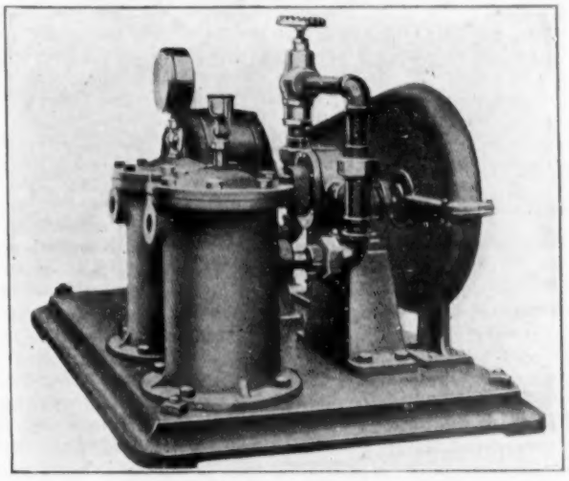
There has just made its appearance a new polishing wheel that is new in name but old to the trade. The Yorkville Manufacturing Comany, Inc., Brooklyn, N. Y., who have been marketing sheepskin polishing wheels for many years, have recently decided to trademark these wheels "Pressto".

These people claim unusually long wearing qualities for Pressto Polishing Wheels, notwithstanding the fact that they will sell at a price very much below the cost of wheels made of most other materials.

NEW OIL PUMP

A new oil pump has been placed on the market by the Maxon Furnace & Engineering Company, Muncie, Ind. All the units are complete with motor, pump, chain drive, gauges, duplex screens, relief valves and priming cup. Different types sold are as follows:

Three-eighths inch pump, ¼ horse power motor, capacity 200 gallons per hour, at 40 pounds.



NEW MAXON OIL PUMP

One-half inch pump, ½ horse power motor, capacity 380 gallons per hour, at 40 pounds.

Three-quarters inch pump, one horse power motor, capacity 625 gallons per hour, at 40 pounds.

NEW OIL HEATER

The Griscom-Russell Company, 90 West street, New York, manufacturers of the well known Reilly Oil Heater of the coil type, have recently placed on the market a new oil heater unit of the straight tube type. This is to supplement their coil heater line and is known as the G-R Oil Heater.

The G-R Oil Heater, as shown in accompanying illustration, is designed for the pre-heating of fuel oil before it goes to the burner and thus aids atomization of the oil and combustion under boilers or in furnaces. The oil is pumped through the tubes and high pressure steam in the shell serves as the heating medium.

The shell of the heater is constructed of wrought steel welded to steel tube plates. The tubes are of seamless drawn steel expanded into tube sheets at either end.

The G-R oil heater is described in Form Sheet 167, published by the manufacturers named above.

ASSOCIATIONS AND SOCIETIES

REPORTS OF THE CURRENT PROCEEDINGS OF THE VARIOUS ORGANIZATIONS

MECHANICAL ENGINEERS

Four hundred members of the American Society of Mechanical Engineers have organized themselves into a Professional Section on Materials Handling and will provide primarily a common channel of intercourse between all the technical and industrial organizations cooperating in the solution of engineering problems connected with the handling and distribution of materials and products.

Side by side with the development of the engineering features of aviation, which are obvious to all, a few minds have for some years been looking beyond the details of construction into the realm of international aircraft problems, and have in fact secured for America a reputation for great breadth of vision regarding the future of air navigation throughout the entire world.

Howard E. Coffin, Jesse G. Vincent, Orville Wright, C. F. Kettering, Elmer A. Sperry, James Hartness, John R. Cautley, Lionel S. Marks, Miller R. Hutchison, Charles E. Lucke and Joseph A. Steinmetz, all prominent in the Aeronautic field in the war, are among those who have registered in the section.

NEW YORK BRANCH A. E. S.

New York Branch of the A. E. S. meets every second and fourth Friday of each month at the Broadway Central Hotel parlors, New York City, N. Y. Secretary, John Burke, 110 Glen street, Brooklyn, N. Y.

President Sterling presided at the September meetings of

New York Branch of the A. E. S. Three applications for active membership were received and referred to the Board of Trustees. Laboratory Chairman Joseph Haas, Jr., read a list of plating problems to be worked out at the laboratory this winter. T. B. Haddow exhibited samples of Die Castings, cold rolled steel and polished steel, nickel plated in a nickel solution containing his magic powder. Advantages gained by adding the magic powder to the nickel solution are rapid deposits, and a higher voltage can be employed. Anodes keep clean, solution contains no sludge. Solution considered ideal for barrel plating. The following plating problems were discussed: The cause of silver deposits peeling on nickel deposits, the difficulty of silver plating, nickel alloys, stripping silver off die castings, stripping fire coating off silver, and the cause of the coating of scale on anodes in a zinc solution.

BOSTON BRANCH, A. E. S.

Boston branch of the American Electro-Plate Society meets every 1st and 3rd Friday of each month at the Quincy House, Boston, Mass., Andrew W. Garrett, Recording Secretary, 37 Dorset street, Dorchester, Mass.

Meeting held Friday, Sept. 17, 1920. President Frances Mackie in the chair. Two applications for membership were received and referred to the board of trustees, and one elected to membership. Much time was taken in the reading of reports from the annual convention and the discussing of the amendment to the constitution referring to assistant foremen. Mr. Herrick has returned to the Boston branch again after being away in the west since last June. He will give the Boston branch a talk on the Pitting of Nickel Work at the next meeting. We have just started, but believe that by the end of winter we will have one of the largest branches in the country.

AMERICAN ELECTRO-CHEMICAL SOCIETY

The thirty-eighth general meeting was held in Cleveland, Ohio, September 30 to October 2, 1920. Among the papers presented were the following:

Faraday's Law at the Cathode, by J. W. Richards.

The Electro-deposition of Brass from Cyanide Solutions, by A. L. Ferguson and E. G. Sturtevant

Tin Plating from Alkaline Tin Baths by the Use of Addition Agents, by F. C. Mather and W. H. Bell.

The Electrolytic Refining of Tin, by Edward F. Kern.

Lead Plating from Sodium Hydroxide Lead Baths by the Use of Addition Agents.

The Solution of Metals in Acids as Related to Corrosion, by Wm. D. Richardson.

ASSOCIATION OF PURCHASING AGENTS

The National Association of Purchasing Agents held its annual convention at the Congress Hotel, Chicago, October 11, 12 and 13. Business sessions were held on each of those dates, the convention being open to all industrial purchasing agents.

At the morning session on October 11 the work of the association in establishing standards of business practice and in national legislative standards were reviewed. At all other sessions there were addresses and discussions. Some of the speakers on the program were Russell A. Pettengill, of the Russell A. Pettengill Co., Chicago, on the subject of "Buying Through Specifications"; Prof. Irving Fisher, of Yale University, on "Stabilizing the Dollar"; Dr. F. W. Russe, of Mallinckrodt Chemical Works, St. Louis, on "Safeguarding the Purchase of Chemicals."

Visits of inspection were paid by the delegates to the packing houses of Chicago and to the Great Lakes Naval Training Station.

On the evening of October 11 the annual banquet of the association was held, featuring speakers of national prominence.

The National Association of Purchasing Agents has a membership of 3,500. Information can be obtained from L. F. Boffey, Secretary, 19 Park Place, New York, N. Y.

NATIONAL INDUSTRIAL TRAFFIC LEAGUE

The Fall Meeting was held at the Selbach Hotel, Louisville, Kentucky, September 30, and October 1, 1920. Particulars can be obtained from S. H. Beek, Executive Secretary, 5 N. La Salle street, Chicago, Ill.

FEDERATED ENGINEERING SOCIETIES

The first meeting will be held in Washington, D. C., November 18-19, 1920, at the New Willard Hotel. Officers will be elected, plans laid for scope and fields of activity.

A constitution and by-laws presented, and an organization meeting held by the Executive Board of the American Engineering Council. Addresses will be given by J. Parke Channing, New York, N. Y., and Herbert C. Hoover, President A. I. M. E.

THE ELECTRIC FURNACE ASSOCIATION

The October meeting was held in Columbus, Ohio, October 6, 1920. The subject for discussion was "Refractories for the Electric Furnace." In addition a visit was made to the laboratory of the Bureau of Mines Station, where some interesting experimentation with refractories is now being carried on. Particulars can be obtained from H. P. Martin, Asst. Secretary, Niagara Falls, N. Y.

NATIONAL SAFETY COUNCIL

The ninth annual Safety Congress was held in Milwaukee, Wis., September 27 to October 1, 1920. Reports can be obtained from Louis Resnick, Editor, National Safety News, 168 North Michigan Avenue, Chicago, Ill.

WASTE MATERIAL DEALERS

A meeting of the Metal Division was held on September 28, 1920, at the Hotel Astor, New York, N. Y. L. D. Waixel presided.

PERSONALS

A. A. Loeffler has been appointed by the Doehler-Die-Casting Company as its Detroit representative, succeeding F. C. Seeger, who will now represent the company on the Pacific Coast, with headquarters in San Francisco.

Herman Grostick, who for years has held a responsible position with the Frederick B. Stevens supply house in Detroit, has accepted a position as representative of the W. A. Fuller Company, of Greensburg, Pa., to handle their line of Natrolin cleansing products in the Detroit district.

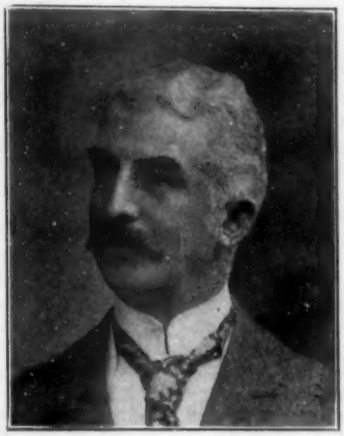
DEATHS

GEORGE W. SHIEBLER

George W. Shiebler died at his home in Brooklyn, in September, 1920. He was the son of Andrew and Mary Shiebler, born 74 years ago in the city of Baltimore. His father was a manufacturer of coach and military braid—one of the last in the business to abandon the hand-made article for the machine-made.

The family moved to Washington, D. C., where George went to school, and upon being graduated, he entered the employ of the Western Union Telegraph Company as a messenger boy. He served as a carrier of despatches during the Civil War, and received many tributes for bravery from the War Department. He once carried an important message to Gen. Warren on the field of battle, and in order to show his appreciation, the General autographed the despatch, and gave it to young Shiebler as a keepsake. This telegram was presented to the Warren Post of the G. A. R. at the dedication of the Warren statue in Prospect Park, Brooklyn.

Upon the death of his father the family moved to Philadelphia, and Mr. Shiebler was transferred to the Western Union offices there, under the supervision of Theodore N. Vail. In 1876, however, he gave up his position with the telegraph company, and went into business for himself as a maker of gold chains. The firm was known as George W. Shiebler & Company. The concern moved to New York and founded a store at 8 Liberty Place. Shortly after this, the name of the firm was changed to The George W. Shiebler Company, which was a part of the Silversmiths' Company—a proposed combination of the Gorham Company, Reed & Barton, Whiting, Dominick & Haff, and the George W. Shiebler Company. The George W. Shiebler Company's part in this combination was to do the breaking down and heavy rolling.



GEORGE W. SHIEBLER

The Silversmiths' Company was never completely organized for some reason or another and the corporation of the George W. Shiebler Company was dissolved. The "and" was again admitted to the firm name, and William F. Shiebler came into partnership with George W. Shiebler. Stores were opened on Maiden Lane and lower Broadway. William F. Shiebler resigned shortly after this, and George W.'s son, Arthur M. Shiebler, came in as partner to his father. The two remained together until the business wound up eleven years ago.

Starting in the small shop at 8 Liberty Place, George W. Shiebler soon moved his business over to the factory of Ketcham & McDougal in Brooklyn. Here he stayed until his own magnificent factory at Underhill and St. Marks avenue, Brooklyn, was completed.

George W. Shiebler was the originator of the curio medalion and "Homeric" style of jewelry. In the manufacture of the latter style a special solution, now known to only one man on earth, Arthur M. Shiebler, must be used. Jewelers all over the country tried to find the ingredients of the solution, but always failed.

Some of the handsomest enameling work ever done in the United States came from the factory of George W. Shiebler—two special artists being employed for this work alone. Five designers and nine die sinkers created exclusive designs, and dies which made George W. Shiebler famous in every silver and jewelry house from coast to coast. One of the greatest regrets in the last years of Mr. Shiebler's life was the fact that when he failed in business the buyers of his factory only took it under the stipulation that every spoon and fork die located therein was to be at once destroyed. The only reason ever designed for this was that the work was so massive that the metal used in each piece made the spoons and forks commercially unprofitable to handle. The destruction of these dies caused great sorrow among all true lovers of sterling silver table appointments.

His love for the beautiful forbade George W. Shiebler's making spoons of the thin light weight, so much in demand by the manufacturers today, who aim only to sell at great profit.

Many famous pieces were made under the personal supervision of George W. Shiebler, among these being the golf trophy awarded to Sir James Cox of England; a replica in sterling silver of the Santa Maria, Columbus' ship, for A. Stowell, of Boston, and the Col. Martin marksman trophy for the 71st Regiment, Inf., N. G. N. Y. This last article cost $3,000 to produce. It bore the equestrian figures of Generals Grant, Sherman and Sheridan—the former two reliefs being exact copies of a monument erected of Grant, and the St. Gaudens statue of Sherman at the 59th street entrance to Central Park.

Elegant pastoral staffs for the bishops of Ohio and Tokio, the former displayed by Congdon & Company, were produced under the personal direction of George W. Shiebler.

George W. Shiebler always took pride in the fact that his company rolled and melted its own silver to the last. His metal was at all times assayed higher than sterling, and his products evidenced individuality more than anything else.

Besides building up the great silverware manufacturing house that you have just read of, George W. Shiebler collected the signatures of all the earth's celebrities and dignitaries, and when he died, owned the most famous autograph album in the world. It was valued at $100,000 and is now in the possession of his grandson, Howard Shiebler. In the book are the names of every President and his wife since Grant; foreign statesmen, such as Wu Ting Fang, the Prince of Siam, Queen Victoria, Edward VII, etc. Sarah Bernhardt joked with Henry Ward Beecher on the last page of the album, and Mme. Emma Calve passed a jest at the Divine Sarah. All of the famous musicians wrote little bars of music in the book; the authors contributed verses or bits of prose, and the artists made little sketches.

George W. Shiebler's travels at home and abroad made him a most interesting man, and an eminent newspaper man once said that in all his career of interviewing "big" people, it was his greatest pleasure, privilege and honor, to have met and known that tenderest, most loving, and most courteous of men, George W. Shiebler. He was the only gentleman, in the strictest sense of the word, that the writer ever knew, or heard of, because in all his life he never caused another person a single moment of physical or mental.—H. A. S.

TRADE NEWS

BUSINESS REPORTS OF THE METAL INDUSTRY CORRESPONDENTS

It will be evident that a large proportion of our monthly letters from correspondents are lacking. This was caused by the wandering astray of a registered letter which contained the manuscripts of the missing reports. We hope to make up this deficiency by giving a report for two months, where necessary, in our next issue.—Ed.

PROVIDENCE, R. I.

OCTOBER 11, 1920.

All lines of the metal industry are experiencing good business with favorable prospects of an indefinite continuance. There has been the same restrictions regarding freight movements that have interfered with receiving of materials and the shipping of products, but it is believed that there are indications of an early relief. The coal situation still exists to keep the manufacturers on the anxious seat, but at present the situation is not so acute as it was a year ago and the outlook is more promising. If anything, the labor situation shows a slight improvement. There are more inquiries for positions and there is less agitation concerning wage increases. It is believed that this latter condition has been brought about largely because of the curtailments in the textile industries that has awakened the laboring classes to the realization that the peak of high pay has apparently been reached.

With the nearly 250 manufacturing jewelry establishments in this city it is natural that the jewelry industry with its numerous and varied allied and kindred branches, should occupy a foremost place in the consideration of business conditions here. All the shops are running about on a normal basis with a fair booking of orders. It is nowhere near such a rushing demand as existed a year ago as the jobbers and retailers have become more rational and are only ordering what they actually need and are not overstocking. It is expected that the jewelry business will continue good until the close of the year and there is every reason to believe that the coming year will also prove satisfactory.

The Fabre Sheet Metal & Roofing Company, Inc., of Pawtucket, has purchased a tract of land embracing 15,800 square feet at the corner of Pine and Wavery streets in that city and will soon begin the construction of a two-story brick building to house their increasing business. The concern is at present located on Timothy street.

Dominick & Haff, one of the largest silver houses in New York, will open a branch factory in the Bliss building, North Attleboro, in the near future. This concern is one of the oldest and most prosperous in the country, and it is said that if everything goes well it is the intention of the firm to move its entire plant to North Attleboro.

H. J. Astle & Company, of this city, has just shipped several of the polishing dust collecting, blower and other Boland systems to the Dennison Watch Case Company in England. The company has installed a large Boland exhaust and dust collecting system in the plant of Wightman & Hough, manufacturing jewelers, in the Manufacturers' Building, 7 Beverly street, this city.

INDIANAPOLIS, IND.

October 11, 1920.

Peter Brisbin, 2754 Allen avenue, formerly a foreman at the Kramm Foundry Company, filed suit, August 27, in Superior Court, Room 5, against the company and Harry D. Kramm, general manager and superintendent, for $25,000 damages. Brisbin alleges that on April 16, 1919, he entered into a contract with the company whereby he was to resign from the Brass and Iron Moulders' Union and assist in defeating strikes at the foundry. He charges that by this contract he was guaranteed a life position with the company at $45 a week. The complaint states Brisbin was discharged January 25.

Articles of incorporation have been filed here by the **Muncie Products Company**, of Muncie, Ind., a new organization that will deal in the manufacture of brass and other red metal products. The company is capitalized at $10,000 and the directors are H. C. R. Wall, L. Jones and Oliver J. Campbell.

Work will start soon on the construction of a foundry building at Michigan street and the Belt railroad for the **Lavelle Foundry Company,** of which Thomas A. Lavelle is president. The building will be one story high, of brick and factory construction and will increase the capacity of the present plant about 40 per cent. The building and equipment will cost approximately $40,000.

LOUISVILLE, KY.

October 11, 1920.

The reports coming from the coppersmiths and workers of metal in Louisville and vicinity show that business is good and the shops busy. With the recent agreement that was reached on labor wage scale things have been running more smoothly in the shops. Present business is good and conditions promising.

While many sections are affected by the slump in automobile business, Louisville has not been materially affected as at the present time she has not any great amount of automobile work, although one or two shops have had a considerable amount of special casting work to do for some of the Northern manufacturers.

Tin has been very scarce and high due to the inability of the sheet mills to supply demand. Paint manufacturers report that advances in cans alone have added five cents to the price of a gallon of paint since present schedules of prices were made effective. Many paint manufacturers have been delayed in getting out production on account of can delay. Some paint and varnish men are now using leaded iron cans, instead of tinned cans.

The railroads are buying much better than they were, but at that most of the material used is in repair work, as railroads are not building cars very freely at the present time.

The Continental Car Company of America, Louisville, builders of railroad dump cars, truck bodies, etc., has recently increased its capital stock to $1,100,000 and plans enlargement of its plant.

George Carney, of the **National Lead Company,** reports a very active demand for all lead products, from metal specialties to white lead.

The Vendome Copper & Brass Company reports a very active volume of business on general work, there being no especially large run on any one line, but a good volume as a whole.

A permit has been issued the **Standard Sanitary Manufacturing Company** for another addition to its plant at a cost of $25,000. The company has spent a considerable amount in enlarging the local A. & O. plant during the past five years.

Permits have been issued to the **Henry Vogt Manufacturing Company** for additions to its plant at a cost of $25,000.

Wesley R. Mason, formerly in charge of the Jeffersonville, Ind., plant of the **American Car & Foundry Company,** has returned from New York and again taken charge. **Charles T. Hertzman** has been made assistant manager.

The Victory Storage Battery Company, capital $20,000, **Arthur Cummings** and others, is opening a new storage battery manufacturing plant at 124 South Sixth street, Louisville.

BIRMINGHAM, ENGLAND.

September 27, 1920.

All the metal trades continue to be well employed, with the exception of the jewelry trade, in which a good deal of short time is being worked and many workpeople have been suspended. For electro-plated articles of the more expensive kinds the demand is still slack, but in articles of daily use a good trade is maintained. Makers of spoons and forks especially are very busy. There is also a good call for cheap fancy articles in electro-plate, but the output of mounted goods is restricted, owing to the difficulty of obtaining suitable glass. A little is coming from Czecho-Slavakia, but the rate of production at present is far below its former volume.

Work for metal rollers and wire drawers is still abundant. Sheets in all the non-ferrous trades are in strong demand and the call for wire, especially of the thinner gauges, is exceptionally good. Brass founders are busy. Good orders are being received from Australia, importers there being anxious to anticipate the proposed increased tariff. The foreign trade in water, steam and electrical fittings has improved. India, among other countries, is taking large supplies of door and window fittings of the better sort. Orders for metal work for passenger ships are plentiful. Copper sheets have been advanced this week £2 per ton, making the price £166. There have also been price increases in brass, sheets, tubes and wire.

Owing to the demands of the motor trade, makers of aluminum hollow-ware find a difficulty in getting sufficient raw material to cope with their growing business. The increasing popularity of aluminum hollow-ware has, during the past year or two, brought several new firms into the trade, and though the aggregate volume of business has increased, some of the older firms are feeling the competition. The steadiness of the metal market has proved very helpful to the metal trades generally. An abundance of scrap, due to Government realizations, is an additional advantage. The large use of scrap brass has helped to keep the price of zinc down to a level at which it is not profitable to manufacture the metal in this country, and three large zinc works have temporarily closed.

A sum of £5,000 has already been raised for the scholarships which the **Birmingham Metallurgical Society** proposes to found at the **Birmingham University** for students.

The serious scarcity of ferro-manganese ore in Great Britain which would create a crisis in the steel trade unless supplies could be speedily and largely increased was the subject of a question put by **Mr. Gritten** in Parliament to the President of the Board of Trade. **Mr. Gritten** asked whether the president knew that great quantities of this ore available in India had passed into late enemy hands and that out of 18,500 tons arriving at Antwerp in June, 12,000 tons went to Germany. **Sir Robert Horne,** President of the Board of Trade, replied that the position had for some time past been receiving the attention of his board in consultation with the India Office and that action had been taken to improve Indian transport conditions. The question of shipments to Antwerp was a matter for the India Office. In reply to a further suggestion by **Mr. Gritten** that the Indian railway policy had seriously affected the supply of ore to Great Britain, **Mr. Montagu** (Secretary of State for India) stated that there were stocks of 74,374 tons at Calcutta and 9,000 tons at Bombay in July. He was aware of United States and Japanese steel trade agencies in India, but he was not aware of any shipment to Antwerp.

VERIFIED NEWS OF THE METAL INDUSTRY GATHERED FROM SCATTERED SOURCES

Raymond E. Lovekin, advertising engineer, will occupy new quarters on the fifth floor of the Fuller Building, 10 South 18th street, Philadelphia, after October 1, 1920.

The Johnson Bronze Company, New Castle, Pa., recently broke ground for an addition to their plant. They operate a brass and bronze foundry, brass machine shop, tool room and grinding room.

The Great Lakes Engineering Works, shipbuilders and engineers, have moved their main offices from the Real Estate Exchange Building, Detroit, Mich., to their River Rouge, Michigan, plant.

The Driver-Harris Company, Middlesex street, Harrison, N. J., has awarded contract to the John W. Ferguson Company, Paterson, N. J., for a two-story building, 60 x 100 feet, to cost about $125,000. They operate a casting shop and cold rolling mill.

The Doehler Die Casting Company, Court and Ninth streets, Brooklyn, has taken bids for extensions and improvements in a one-story building to cost about $20,000. The improvement has been postponed, however. The company operates a brass foundry, brass machine shop, tool room and grinding room.

The Magnolia Metal Company of Canada, Ltd., 120 St. James street, Montreal, Que., have awarded the contract for the construction of a one-story, 48 x 75 ft. factory; estimated cost, $17,000. They are in the market for a reverberatory furnace and solder plant. They operate a smelting and refining department.

The United States Hardware Corporation have established a plant in the new building of the Acorn Silk Company, Freeman and William streets, Long Island City, N. Y., where they manufacture brass and copper goods. Their principal product will be curtain rods. They operate a brass machine shop, tool room, stamping, plating, polishing and lacquering departments.

The Phoenix Brass Foundry, Inc., Irvington, N. J., has been incorporated with a capital of $100,000 by Charles Donath and Sidney M. Cowan, 755 South Twelfth street, Newark, to manufacture brass and bronze castings and other metal products. This firm operates a smelting and refining department, brass, bronze and aluminum foundry, brass machine shop, tool room, grinding room and casting shop.

Construction has been completed of a plant for the **Shea-Clancy Casting Company,** 230 Fifth street, Bridgeport, Conn., and work will start in the new building as soon as all necessary equipment has been installed. The company is now in the market for a small core oven, 12 x 18 feet, a steel or iron flask tumbling barrel, sprue cutter, three horse power motor and grinder and small tools and supplies. They operate a brass, bronze and aluminum foundry.

The American Brass Company, Ansonia, Conn., is beginning work on a brick and steel mill structure, one story, 330 x 400 ft. long, as an addition to its hot rod and copper wire mill. This is one of the largest additions planned by the company here in recent years, and its estimated cost is $700,000. Contract for steel for the building has been placed with the American Bridge Company and work on the structure will be done partly by contract and partly by the brass company.

Erection of a new plant, 40 x 125 feet, is being planned by the **Shreveport Brass Works,** Shreveport, La. It is proposed to install a large amount of new equipment. R. J. Morton is manager. They are operating a brass foundry, brass finishing machine shop and have just installed a white metal plant for making babbitts, solders and type metals. All equipment has been purchased and installed, but they are continually in the market for tin, lead, antimony, ingot copper, brass and zinc.

The Case Novelty Manufacturing Company, of New York, has recently branched off to high class production of fancy metal vanity cases. This industry has been totally unknown within and about New York City and it is looked upon with great interest both by the metal trades and the perfumery and toilet goods laboratories. This new department will have a capacity production reaching the million mark when in full operation and, owing to a new method of finishing these articles, will greatly reduce their cost.

Charles F. Noyes Company will move about September 26 to 118 William street, owned and to be occupied in part by the company. The new building was designed from plans of Clinton & Russell and constructed by Bernard F. Golden, builder. The lot is 25 x 130 feet and the Noyes company executive offices will be on the ground floor and the other departments upstairs. The building adjoins the 20-story office structure at the northeast corner of John and William streets and is only a few doors removed from the Noyes company's present offices.

The Metal and Thermit Corporation, 120 Broadway, New York City, has made arrangements to secure life insurance for all its employees who have been with the company for at least six months. The amounts of protection are graded according to the length of service, and range from $700 for six months' service up to $3,000 for twenty years'. The insurance is to be paid in monthly payments during the first year after death. The company bears the entire expense of this insurance, which is in addition to any compensation to which its employees might be entitled under the present state compensation laws.

Dwight P. Robinson & Company, Inc. (with which Westinghouse, Church, Kerr & Co., Inc., has recently consolidated), engineers and constructors, of New York, has established a new branch office in Youngstown, Ohio, in the Home Savings and Loan Building, in charge of C. I. Crippen. The company recently moved its Cleveland office from the Leader-News Building to the Citizens Building, and H. P. Clawson, who was for several years a member of the Chicago staff, has been transferred to Cleveland to take charge of this office. The company now maintains branch offices in Pittsburgh, Youngstown, Cleveland, Chicago, Dallas and Los Angeles, and Sao Paulo, Brazil.

The Hart Company, Williamsport, Pa., was recently incorporated in Pennsylvania, for $100,000, by Walter Hart, Harry A. Miller, LeRoy W. Gleason, and others. The concern will manufacture a complete line of valves, faucets, basins, cocks, etc. The factory is completely equipped, having a foundry with force draft furnaces, molding machines, sand blast equipment, etc., and in addition to its own work can handle contract work ranging in size from one ounce to fifty pounds. The machine shop is equipped with turret and fox lathes, milling machines, etc., and has special equipment for the making of tools and patterns. The buffing and polishing department is also fully equipped. The plant is so located as to be able to take care of an extensive expansion of business.

ENAMELED METAL TECHNICIAN

The United States Civil Service Commission announces an open competitive examination for assistant enameled metal technician in the Bureau of Standards, Washington, D. C., at $1,000 to $1,500 a year; open to both sexes. Send for Form 1312. Application must be filed, properly executed, by October 26, 1920.

FOUNDRY EQUIPMENT FIRMS MERGE

Announcement is made of the consolidation of two well-known non-competing foundry equipment manufacturing companies, the Whiting Foundry Equipment Company, of Harvey, Ill., and the American Foundry Equipment Company, of New York City.

The new organization will be known as Whiting Corporation and will be capitalized at $5,000,000. J. H. Whiting, president of the Whiting Foundry Equipment Company, becomes chairman of the board, and V. E. Minich, president of the American Foundry Equipment Company (sand mixing machine company) and of the Foundry Equipment Manufacturers Association, will be president.

The plans include maintaining and enlarging the present

offices of the American Foundry Equipment Company, 366 Madison avenue, New York, as the Eastern sales and export office of the combined lines.

PRODUCTION OF REFINED PRIMARY LEAD IN THE UNITED STATES

	1918 (Short tons)	1919 (Short tons)
Domestic desilverized lead	282,024	208,751
Domestic soft lead	210,463	147,744
Domestic desilverized soft lead	47,418	67,938
	539,905	424,433
Foreign desilverized lead	100,290	57,787
Total refined primary lead	640,195	482,220
Production of antimonial lead	18,570	13,874

APPARENT CONSUMPTION OF REFINED PRIMARY LEAD IN THE UNITED STATES, REFINERY STOCKS DISREGARDED.

Supply:		
Stock in bonded warehouses, Jan. 1	2,685	472
Imports of pigs, bars, and old	5,240	5,107
Production	640,195	482,220
	648,120	487,799
Withdrawn:		
Exports of foreign lead from warehouse	59,416	40,976
In manufactures, with benefit of drawback	3,426	1,936
Exports of domestic lead	41,831	10,510
Stock in bonded warehouses, Dec. 31	472	234
	105,145	53,656
Apparent consumption	542,975	434,143
Lead content of ore and bullion remaining in warehouses, Dec. 31*	16,999	45,476

* Some part of this may have been smelted and refined and thus be included in the quantities given above as "Foreign desilverized lead."
Prepared by C. E. Siebenthal, U. S. G. S.

GOVERNMENT PUBLICATIONS

Mineral Resources of the United States in 1919—Preliminary summary with introduction by G. F. Loughlin. Statistics assembled by Martha B. Clark, from data furnished by specialists of the Division of Mineral Resources. Published by U. S. Geological Survey.

TRADE PUBLICATIONS

National Safety News.—The publication of the National Safety Council, Chicago, Ill.

Fifth Annual Report of the Industrial Hospital of the Scovill Manufacturing Company, Waterbury, Conn.

Meco Metal.—A description of an acid resisting metal for mine and industrial pumps, put out by the Midwest Engine Company, Indianapolis, Ind.

Acids.—Bulletin No. 11, from Velie, Blackwell and Buck, 49 Wall Street, New York City, covering acids, organic and inorganic, which they handle.

Armstrong Cork Tile.—A pamphlet on cork tile for flooring of offices, etc., issued by the Armstrong Cork and Insulation Company, Pittsburgh, Pa.

Magnetic Separators.—Bulletin No. 81, issued by the Dings Magnetic Separator Company, for reference to their various types of machines which they build.

Linotile Floors.—A catalogue of flooring material for the same purposes as cork tile, issued by the Armstrong Cork and Insulation Company, Pittsburgh, Pa.

Traveling Water Screens.—Book No. 352, published by the Link-Belt Company, Chicago, Ill. An illustrated and very attractive 24-page book covering their traveling water screens.

Reilly Water Heater.—Bulletin No. 260, issued by the Griscom-Russell Company, 90 West Street, New York City, covering the construction and operation of this heater.

Studies in the Economics of Lighting, by E. Leavenworth Elliott.—A reprint from the "Central Station" by permission, issued by the Cooper-Hewitt Electric Company, Hoboken, N. J.

American Foundry Flasks.—A catalogue issued by the American Foundry Equipment Company, New York City, covering foundry flasks of steel, aluminum, wood and cast iron.

Panel Boards and Cabinets.—A publication from the Benjamin Electric Manufacturing Company, Chicago, Ill., covering their standardized panel boards, cabinets, etc.

Westinghouse Electric Ovens.—Miniature catalogue 9-A-1, covering electric heating equipment for ovens, control equipment for enameling ovens, and Westinghouse standardized electric ovens.

Brass Melting.—A booklet covering in very brief and easily understood fashion the development of electric furnaces for melting brass. Issued by the Acheson Graphite Company, Schenectady, N. Y.

Electric Air Compressors, Portable Electric Drills, and Electric Valve Grinders.—A new and very attractively arranged catalogue issued by the Black and Decker Manufacturing Company, Baltimore, Md.

Manager and Industrial Engineer.—Blue Book Series No. 2, by J. P. Jordan, published by C. E. Knoeppel & Co., Inc., New York City. A short analysis of the work of a plant manager, and his contacts with the industrial engineer.

Baily Electric Furnaces.—Bulletin 9-b, on melting nonferrous metals, annealing and heat treating, issued by the Electric Furnace Company, Alliance, Ohio. This catalogue shows various styles of metal melting furnaces and also of the new heat treating and annealing furnaces.

G. E. Insulating Compounds.—Bulletin No. 48704-A, issued by the General Electric Company, Schenectady, N. Y., which supersedes Bulletin No. 48704, presenting the principle characteristics and effective adaptations of the wide field of insulating and coating materials in a practical manner.

Keep the Guess Work Out of Welding.—A pamphlet issued by the American Welding Society, Chicago Section, 608 South Dearborn Street, Chicago, Ill., explaining the movement sponsored by the American Welding Society, to the end that there may be combined action to strengthen the cause of autogenous welding.

Nonpareil Insulating Brick.—A rather elaborate catalogue issued by the Armstrong Cork and Insulation Company, Pittsburgh, Pa., on brick for furnaces, boiler settings, ovens, hot blast stoves, hot blast mains, brick and pottery kilns, bake ovens, and hot surfaces generally. The book is attractively and substantially bound and profusely illustrated.

Electric Hoists.—The revised edition of catalog No. 38, which is now off the press and available for distribution. This 96-page book covers the Link-Belt line of standardized monorail electric hoists as well as overhead electric traveling cranes in capacities of ½ to 3 tons inclusive. It completely describes these machines,—giving tables of weights, clearance dimensions and speeds, and is copiously illustrated. Published by the Link-Belt Company, Chicago, Ill.

METAL STOCK MARKET QUOTATIONS

	Par	Bid	Asked
Aluminum Company of America	$100	$600	$650
American Brass	100	191	197
American Hardware Corp	100	135	138
Bristol Brass	25	24	26
International Silver, com	100	30	..
International Silver, pfd	100	87	..
New Jersey Zinc	100	170	175
Rome Brass & Copper	100	140	150
Scovil Mfg. Co	100	360	390
Yale & Towne Mfg. Co	..	270	285

Corrected by J. K. Rice, Jr., & Co., 36 Wall Street, New York.

METAL MARKET REVIEW

WRITTEN FOR THE METAL INDUSTRY BY W. T. PARTRIDGE.

COPPER.

Sales of copper in September by large producing interests are estimated at 60,000,000 lbs., being about 8,000,000 lbs. larger than in August. Including sales in the outside market for both domestic shipment and for export, probably about 70,000,000 lbs. were sold. It is encouraging that such an amount of metal was disposed of under trying circumstances, but most of the sales were made at the expense of prices. The decline in September was fully ½c. a lb. in both the major and minor markets and since the first of October there has been a further decline of ½c. a lb. Today producing interests are accepting orders at 18c. delivered for electrolytic and in the open market there are offerings at 17½c. f. o. b. refinery; in fact, some sales were made in the interior as low as 17½c. delivered. Lake copper has receded to the same price as electrolytic, that is, 18c. delivered in the outside market. Casting copper is heavy and, in sympathy with electrolytic, has dropped to 17¼c. for October shipment at producers' works.

It should be noted that with the advance in freight rates which producers absorbed the decline in prices of copper in the last six weeks has been equivalent to 1½c. a lb. It is estimated that during the third quarter of the year, large producers sold 212,000,000 lbs., in the second quarter 240,000,000 lbs. and in the first quarter 650,000,000 lbs., or a total during the first nine months of 1,100,000,000 lbs. Deliveries into domestic consumption during the first nine months were approximately 1,000,000,000 lbs. Exports in September are estimated at 15,000 tons, or approximately 33,600,000 lbs. During the first nine months of the year foreign shipments aggregated about 515,000,000 lbs. Thus total deliveries into domestic and foreign consumption from January 1 to October 1 were 1,515,000,000 lbs.

Production of refined copper in the United States during the first nine months of the year probably averaged close to 150,000,000 lbs. a month, a total of 1,350,000,000 lbs., which subtracted from the total deliveries indicates that about 165,000,000 lbs. were drawn from stock, leaving the surplus on the first of October about 535,000,000 lbs. It should be recalled that about 70,000,000 lbs. of refined copper were carried on consignment to Europe by producing interests as well as 631,000,000 lbs. in the United States on January 1, so that there was a total stock of 700,000,000 lbs when the year began. The fact that this large surplus has been reduced is encouraging, but stocks are still too heavy for comfort as domestic consumption has been reduced from 130,000,000 lbs. early in the year to between 80,000,000 and 100,000,000 lbs. in September. Exports during the last 60 days have fallen off sharply.

TIN.

In the domestic market prices of pig tin for both spot and future shipment steadily declined, as the recoveries in prices of tin at London from time to time were almost always offset by lower rates for sterling exchange. The net decline in New York was 3c. a lb. on spot and 1¼c. a lb. on futures Straits. Other kinds of tin also declined, although less sharply than Straits On the closing day of the month spot Straits tin sold at 42¾ and futures at 43.50c. One interesting development was the steady liquidation of accounts in this market, as well as abroad, reflected in auction sales on the New York Metal Exchange in connection with disputed or defaulted contracts.

The foreign markets were more active, but at the expense of prices, there being a net decline of £4 on spot standard and £5 on future standard at the close of the month, spot selling at £268 and futures at £275. Spot Straits tin at London dropped £10, the closing price being £270. At Singapore the price drapped £11 15s. net, the closing price on September 30 being £277 c. i. f. London.

Deliveries of tin into domestic consumption in September were 4,860 tons against 3,745 tons in August this year and 4,825 tons in September last year. The total supply available during the month was 8,591 tons, and stocks at the end of the month were 3,731 tons. There were also afloat for the United States 6,185 tons, making the American visible 9,916 tons.

ZINC.

The most important development in zinc during the month was the free offering of the American product for reshipment from England, which movement was encouraged by the low rates prevailing for sterling exchange. The prices steadily declined here both on the Atlantic Seaboard and in the interior, the net recession being 20 to 55 points on reshipment metal and 35 to 45 points on prime western in the interior. There was considerable buying of imported material at New York and other eastern ports, but in the interior the market was dragging, although for a short time there was some increase in the demand from galvanizers.

At the beginning of the month prime western sold at East St. Louis at 8c. for prompt and September shipment, while the New York prices were 8.30 to 8.40c. for prompt and 8.10c. for September. At the close of the month, however, prime western in New York sold at 7.75 to 7.85c. for prompt and September and 7.65 to 7.75c. for October and November shipment, while at St. Louis the price had dropped to 7.65 for prompt, September and October and 7.70 to 7.80c. for November shipment.

It is interesting to note that the American spelter which was being sold in Great Britain for importation here at 7¾c. a lb., free of duty, had previously been sold to England in July and August at 9c. a lb., but the fact that Germany was pressing sales of its output in the English market at lower prices, made it possible to replace the metal sold for importation here, probably at a profit. Germany has evidently become quite a disturbing factor in all the metal markets of the world.

Production of zinc in this country was sharply reduced in the last few months. The July production was about 38,226 tons. August output is estimated at 30,000 tons and September about 29,000 tons. This curtailment was necessary to offset the reduced domestic demand and the temporary loss of export trade.

LEAD

The drop of ¾ to ¼c. a lb. in the price of lead in the domestic market in September was the result of the increased offerings of foreign lead for importation to this country, together with the curtailment of home consumption. The American Smelting & Refining Company reduced official prices ½c. a lb. on September 13 and again on September 23, and another reduction of ¼c. a lb. on September 29; that is, the spot price was reduced from 9c. at the beginning of the month to 7¾c. at the end of the month. Independent producers reduced prices from 8½c. for prompt and September shipment at the beginning of the month to 7¾c. at the close of the month.

It is estimated that 20,000 tons of foreign lead have been booked for shipment to this country, but evidently all of the arrivals thus far are needed to compensate for the small domestic production which followed as a result of labor difficulties at producing plants in the west. Until late in September all of the foreign material imported here came from Great Britain and Australia, but one lot of 450 tons was shipped from Hamburg, and more German lead is being offered. Late in the month foreign lead was offered as low as 7.40c. delivered in New York, duty paid, for prompt and October shipment from the United Kingdom, but this price was subsequently advanced at 7½c. The low rates of sterling exchange stimulated the foreign movement. Notwithstanding the arrivals of foreign lead, there is no surplus as yet for prompt delivery either on the Atlantic Seaboard or in the interior. Lead ore declined from $110 at the beginning of the month to $80 at the close, a recession of $30 a ton as a result of the steady decline in the prices of the metal, and to large importations of ore from Australia and Mexico.

ALUMINUM

The Aluminum Company of America had made no change in its prices in September, notwithstanding the free offerings of European production for importation into this country. It was claimed that the largest American interest in advancing its prices in August based its action on world conditions, anticipating no serious competition from Great Britain, Switzerland, Norway, France or Germany during the remainder of this year. On the other hand, readjustment in industry, which is forcing prices of commodities downward, eventually caused a readjustment of prices of the domestic product. For a time being, the Aluminum Company's price remained 35.10c. for 99% and purer; 34.90c. for 98-99%; 34.10c. for No. 12 alloy and 49.20c.

for sheets No. 18 gauge. However, a cut came early in October, 2c. per lb. off all prices making them 33.10c. for 99% and purer; 32.90c. for 98-99%; 32.10c. for No. 12 alloy and 47.20c. for sheets No. 18 gauge. In the outside market, however, there was a drop of 3c. a lb. during the month as a result of arrivals of Swiss and Norwegian metal which was pressingly offered. Late in the month also, German aluminum was offered through Paris. Domestic consumers were reluctant buyers, being already well covered on contracts. At the beginning of the month, virgin aluminum was offered at 32 to 32½c., remelted 98 to 99% at 31½ to 32c. and No. 12 at 28 to 30c. a lb., but sheet aluminum was scarce and for early deliveries it was possible to obtain even higher prices than those asked by manufacturers. As the market became flooded with foreign material, prices dropped heavily, and when the month closed spot virgin ingots were offered at 29 to 30c., 98 to 99% remelted at 28 to 29c., and No. 12 at 27 to 28c. a lb., with the tendency of prices still downward.

ANTIMONY

Business in antimony in September continued to be confined to relatively small lots and changes in prices were small. At the beginning of the month, spot and September shipment antimony was offered at 7c. in carload lots and some business was done at this price. Jobbing lots ranged from 7¼ to 7¾c. a lb. As the demand improved, the market was a little firmer in tone, prices advancing to 7½c. for spot and September shipment in carload lots. Prices were well sustained during the first three weeks of the month with few outside lots offered. Stocks, however, were ample to meet current requirements.

Conditions in the Orient were unchanged, that is, production was still curtailed because of political conditions and prices asked for shipment from China were above those current in the domestic market, consequently very little business was done for importation. Late in the month an easier tone developed here as a result of large offerings from England of antimonial lead and ammunition carrying 9% antimony. These offerings were at very satisfactory prices to consumers, and as a result an easier tone prevailed for the metal. As the month closed, there were also some freer offerings from China and sales were made at 6¾c. for shipment from the Far East. The spot market remained dull and prices were unchanged at 7c. for carload lots, while jobbing lots continued to be held at 7¼ to 7¾c. a lb., the same as on the first of the month.

SILVER

Small purchases of silver were made on Chinese account during the month, but India displayed little interest. Domestic buying was light and the tendency of prices of metal of foreign origin was downward, the closing price on September 30 being 92c. an ounce against 92¾c. at the end of August. The highest price made during the month was 95c. and the lowest price 91½c. The London market was weaker because the Indian Government refused to sell sterling drafts on London. The United States Government up to the end of September had purchased 16,000,000 ounces of silver under the Pittman Act. The price of silver of domestic origin remained unchanged at 99½c. throughout the month.

QUICKSILVER

A very dull but steady market was experienced for quicksilver throughout September, the price remaining unchanged at $75 per flask of 75 lbs.

PLATINUM

Platinum receded about $5 per ounce in September from the high price established at the end of August, and thereafter the market continued firm but quiet at $115 per ounce.

OLD METALS

Business in old metals throughout September was dull. Although transportation difficulties were largely removed there was very little increase in shipment of old metals to consumers. The outlook is not very encouraging for dealers and the tendency of prices in all lines is downward in sympathy with new material. There was, however, some increase in the demand for scrap copper, especially for crucible copper, which was scarce. Numerous small brass founders were in the market for small lots. Much of this material is obtained direct from junk dealers who gather the material in wagons. Lead scrap, of course, felt the break of ¼ to ¾c. a lb. in the price of new metal. Aluminum scrap was dull as a result of the falling off in the automobile trade. Aluminum smelters have made few purchases. Brass and composition metal has declined. Light copper receded from 13½ to 13¼c., while crucible copper, being scarce, commanded 15 to 15¼c. against 15½c. a month ago. Uncrucible copper receded ½c. a lb. to 13½ to 14c. The price of heavy lead dropped to 6¼ to 6½c. from 7½c. a month ago. Tea lead receded to 3¾ to 4c. New zinc scrap declined ½ to ¾c. a lb., being held at 5¾ to 6c. Old zinc scrap declined ¼ to ¾c. to 4½ to 5c. Aluminum clippings dropped 1 to 2c. a lb. to 23c. Old sheet broke 4c. to 18c. and old cast aluminum sold at the same price, a drop of 2c. a lb. Block tin pipe continued steady at 35c. Heavy brass was held at 8c., No. 1 brass turnings at 7½ and new brass clippings at 9c. per lb.

WATERBURY AVERAGE

Lake Copper. Average for 1919, 19.55. 1920—January, 19.25. February, 19.125.—March, 18.875.—April, 19.125.—May, 19.00.—June, 18.50—July, 19.00—August, 18.75—September, 18.75.

Brass Mill Zinc. Average for 1919, 8. 1920—January, 9.75. February, 9.40.—March, 9:15.—April, 8.85.—May, 8.30.—June, 8.15.—July, 8.45—August, 8.55—September, 8.45.

SEPTEMBER MOVEMENTS IN METALS

	Highest.	Lowest	Average.
Copper:			
Lake	18.75	18.25	18.527
Electrolytic	18.25	17.37½	18.045
Casting	18.00	17.50	17.765
Tin	45.75	42 75	44.619
Lead	8.75	7.75	8.20
Zinc (brass special)	8.50	7.85	8.175
Antimony	7.12½	7.00	7.101
Aluminum	32.50	29.00	31.44
Quicksilver (per flask)	$75.00	$75.00	75.00
Silver (cts. per oz.) Foreign	95.00	91.50	93.655

Metal Prices, October 11, 1920

NEW METALS

Open Market

	Cents
COPPER—DUTY FREE. PLATE, BAR, INGOT AND OLD COPPER. Manufactured 5 per centum.	
Electrolytic, carload lots, delivered	18
Lake, carload lots, delivered	18
Casting carload lots, delivered	17¼
TIN—Duty Free.	
Straits of Australian, carload lots	42.50
LEAD—Duty Pig, Bars and Old, 25%; pipe and sheets, 20%. Pig lead, carload lots	7.75
ZINC—Duty 15%.	
Brass Special	7.75
Prime Western, carload lots	7.60
ALUMINUM—Duty Crude, 2c. per lb. Plates, sheets, bars and rods, 3½c. per lb.	
Small lots, f. o. b. factory	....
100-lb., f. o. b. factory	....
Ton lots, f. o. b. factory	30-33.10
ANTIMONY—Duty 10%.	
Cookson's, Hallet's or American	Nominal
Chinese, Japanese, Wah Chang WCC, brand spot	6.75-7.00
NICKEL—Duty, Ingot, 10% ad valorem. Sheet, strip, strip and wire, 20%.	
Ingot	43.00
Shot	43.00
Electrolytic	45.00
MANGANESE METAL	Nominal
MAGNESIUM METAL—Duty 20% ad valorem (100 lb. lots)	$1.60-$1.75
BISMUTH—Duty free	2.55-2.57
CADMIUM—Duty free	$1.40-$1.50
CHROMIUM METAL—Duty free	Nominal
COBALT—97% pure	$6.00
QUICKSILVER—Duty 10% per flask of 75 pounds	$75
PLATINUM—Duty free, per ounce	$115
SILVER—Government assay—Duty free, per ounce	.99½
GOLD—Duty free, per ounce	$20.67

Metal Prices, October 11, 1920

INGOT METALS

Silicon Copper, 10%	according	to	quantity	49	to55
Silicon Copper, 20%	"	"	"	36	to40
Phosphor Copper, guaranteed 15%	"	"	"	25	to32
Phosphor Copper, guaranteed 10%	"	"	"	24	to31
Manganese Copper, 30%	"	"	"	60	to66
Phosphor Tin, guarantee 5%	"	"	"	60	to65
Phosphor Tin, no guarantee	"	"	"	45	to55
Brass Ingot, Yellow	"	"	"	12½	to14
Brass Ingot, Red	"	"	"	17	to19
Bronze Ingot	"	"	"	17½	to20
Parsons Manganese Bronze Ingots	"	"	"	22½	to24
Manganese Bronze Castings	"	"	"	32	to42
Manganese Bronze Ingots	"	"	"	17	to21
Manganese Bronze Forgings	"	"	"	30	to40
Phosphor Bronze	"	"	"	24	to30
Casting Aluminum Alloys	"	"	"	27	to32
Monel Metal	"	"	"	38	to..

OLD METALS

Buying Prices.		Selling Prices.
13 to13½	Heavy Cut Copper	14¼to14½
12¾to13	Copper Wire	14 to14½
11 to11½	Light Copper	13 to13½
12½to13	Heavy Machine Comp	14½to15
8½to 9	Heavy Brass	10½to11
6 to 6½	Light Brass	8 to 8½
7 to 7½	No. 1 Yellow Brass Turnings	9 to 9½
12 to12½	No. 1 Comp. Turnings	14 to14½
4.25	Heavy Lead	4.90
4.25	Zinc Scrap	5.00
7 to10	Scrap Aluminum Turnings	8 to11
16 to18	Scrap Aluminum, cast alloyed	18.50to20.00
19.00	Scrap Aluminum, sheet (new)	21½
26.00	No. 1 Pewter	30.00
15.00	Old Nickel anodes	17.00
23 to25	Old Nickel	27 to29

BRASS MATERIAL—MILL SHIPMENTS

In effect August 23, 1920.

To customers who buy 5,000 lbs. or more in one order.

	Net base per lb.		
	High Brass.	Low Brass	Bronze.
Sheet	$0.25¼	$0.27¼	$0.29
Wire	.25¾	.27¾	.29½
Rod	.23¾	.28	.30
Brazed tubing	.38	..	.42¾
Open seam tubing	.38	..	.42¾
Angles and channels	.43	..	.47¾

To customers who buy less than 5,000 lbs. in one order.

	Net base per lb.		
	High Brass.	Low Brass.	Bronze.
Sheet	$0.26½	$0.28½	$0.30¼
Wire	.27	.29	.30¾
Rod	.25	.29¼	.31¼
Brazed tubing	.39¾	..	.44
Open seam tubing	.39¼	..	.44
Angles and channels	.44¼	..	.49

SEAMLESS TUBING

Brass, 30½c. to 32½c. per lb. base.
Copper, 32c. to 34c. per lb. base.

TOBIN BRONZE AND MUNTZ METAL

Tobin Bronze Rod	29½c.	net base
Muntz or Yellow Metal Sheating (14"x48")	25¼c.	" "
Muntz or Yellow Rectangular Sheets other than Sheathing	26¼c.	" "
Muntz or Yellow Metal Rod	23¾c.	" "

Above are for 100 lbs. or more in one order.

COPPER SHEET

Mill shipments (hot rolled)	29½c. net base
From stock	33½c-35c net base

BARE COPPER WIRE—CARLOAD LOTS

22c. to 22½c. per lb. base.

SOLDERING COPPERS

300 lbs. and over in one order	30½c. per lb. base
100 lbs. to 300 lbs. in one order	31½c. " " "

ZINC SHEET

Duty, sheet, 15%. Cents per lb

Carload lots, standard sizes and gauges, at mill, 12½c. basis less 8 per cent. discount.

Casks, jobbers' prices	14c.
Open casks, jobbers' prices	14½c

ALUMINUM SHEET AND COIL

Aluminum sheet and coil, base price	49.10c per lb. contract price
Aluminum sheet and coil	65-70c per lb. open market price

BLOCK TIN SHEET AND BRITANNIA METAL

Block Tin Sheet—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more, 10c. over Pig Tin. 40 to 100 lbs., 15c., over 25 to 50 lbs., 17c. over, less than 25 lbs., 25c. over.

No. 1 Britannia—18" wide or less. No. 26 B. & S. Gauge or thicker, 500 lbs. or over, 8c. over N. Y. tin price; 100 lbs. or more, 10c. over Pig Tin. 50 to 100 lbs., 15c. over, 25 to 50 lbs., 20c. over, less than 25 lbs., 25c. over.

Above prices f. o. b. mill.

Prices on wider or thinner metal on request.

MONEL METAL

Shot	35
Blocks	35
Sheet Bars	40
Hot Rolled Rods (base)	40
Cold Drawn Rods (base)	56
Hot Rolled Sheets (base)	55

Lead Foil—base price—figured on base price of lead at the time.

Platers' metal, so called, is very thin metal not made by the larger mills and for which prices are quoted on application to the manufacturer.

SILVER SHEET

Rolled silver anodes .999 fine are quoted at from 88c. to 90c. per Troy ounce, depending upon quantity.

Rolled sterling silver, 85c. to 88c.

NICKEL ANODES

85 to 87% purity	.55c.	per lb.
90 to 92% "	.57½c.	per lb.
95 to 97% "	.60c.	per lb.

Supply Prices, October 11, 1920

CHEMICALS

Acid--		
Boric (Boracic) Crystals	lb.	.30
Hydrochloric (Muriatic) Tech., 20 deg., Carboys	lb.	.08
Hydrochloric, C. P., 20 deg., Carboys	lb.	.10
Hydrofluoric, 30%	lb.	.50
Nitric, 36 deg. Carboys	100 lb.	8.28
Nitric, 42 deg. Carboys	100 lb.	8.90
Sulphuric, 66 deg., Carboys	lb.	.04½
Alcohol—		
Denatured	gal.	1.50
Alum—		
Lump, Barrels	lb.	.08
Powdered, Barrels	lb.	.09
Aluminum sulphate, commercial tech	lb.	.06
Aluminum chloride solution	lb.	.30
Ammonium—		
Sulphate, tech., Barrels	lb.	.08½
Sulphocyanide	lb.	1.50
Argols, white, see Cream of Tartar	lb.	.80
Arsenic, white, Kegs	lb.	.18
Asphaltum	lb.	.35
Benzol, pure	gal.	.75
Blue Vitriol, see Copper Sulphate.		
Borax Crystals (Sodium Biborate), Barrels	lb.	.10½
Calcium Carbonate (Precipitated Chalk)	lb.	.20
Carbon Bisulphide, Drums	lb.	.12
Chrome Green	lb.	—
Cobalt Chloride	lb.	—
Copper—		
Acetate	lb.	.60
Carbonate, Barrels	lb.	.29
Cyanide	lb.	.68
Sulphate, Barrels	lb.	.09
Copperas (Iron Sulphate, bbl.)	lb.	.04
Corrosive Sublimate, see Mercury Bichloride.		
Cream of Tartar, Crystals (Potassium bitartrate)	lb.	.80
Crocus	lb.	.15
Dextrin	lb.	.25
Emery Flour	lb.	.10
Flint, powdered	ton	—
Fluor-spar (Calcic fluoride)	ton	—
Fusel Oil	gal.	6.50
Gold Chloride	oz.	14.00
Gum—		
Sandarac	lb.	—
Shellac	lb.	—
Iron, Sulphate, see Copperas, bbl	lb.	.04
Lead Acetate (Sugar of Lead)	lb.	.35
Yellow Oxide (Litharge)	lb.	.25
Mercury Bichloride (Corrosive Sublimate)	lb.	1.95
Nickel—		
Carbonate Dry	lb.	.80
Chloride, 100 lb. lots	lb.	.55
Salts, single, bbls	lb.	.16
Salts, double, bbl	lb.	.14
Paraffin	lb.	.30
Phosphorus—Duty free, according to quality		.37-.45
Potash, Caustic, Electrolytic 88-92% fused	lb.	.32
Electrolytic 70-75%, fused	lb.	.26
Potassium Bichromate, Casks	lb.	.33
Carbonate, 80-85%	lb.	.23
Cyanide, 98-99½%, 100 lb. cases	lb.	—
Pumice, ground, bbls	lb.	.05
Quartz, powdered	ton	—
Official	oz.	—
Rosin, bbls.	lb.	.08
Rouge, nickel, 100 lb. lots	lb.	.40
Silver and Gold	lb.	.60
Sal Ammoniac (Ammonium Chloride) in casks	lb.	.16
Sal Soda	lb.	—
Silver Chloride, dry	oz.	1.43
Cyanide	oz.	—
Nitrate, 100 ounce lots	oz.	.62¾
Soda Ash, 58%, bbls	lb.	.03½
Sodium—		
Biborate, see Borax, bbls	lb.	.10½
Bisulphite, tech. bbls	lb.	.09
Cyanide, 96 to 98%, 100 lbs	lb.	.27
Hydrate (Caustic Soda) bbls	lb.	.07½
Hyposulphite, kegs	lb.	.06
Nitrate, tech., bags	lb.	.08
Phosphate, tech., bbls	lb.	.08
Silicate (Water Glass) bbls	lb.	.03
Sulpho Cyanide	lb.	.90
Soot, Calcined	lb.	—
Sugar of Lead, see Lead Acetate	lb.	.35
Sulphur (Brimstone) bbls	lb.	.04
Tin Chloride	lb.	65
Tripoli Composition	lb.	.02½
Verdigris, see Copper Acetate	lb.	.60
Water Glass, see Sodium Silicate, bbls	lb.	.03
Wax—		
Bees, white ref. bleached	lb.	1.00
Yellow No. 1	lb.	.60
Whiting	lb.	.10
Zinc, Carbonate, bbls.	lb.	.26
Chloride, 600 lb lots	lb.	.15
Cyanide	lb.	.49
Sulphate, bbls	lb.	.06

COTTON BUFFS

Open buffs, per 100 sections (nominal).		
12 inch, 20 ply, 64/68, cloth	base,	$90.55
14 " 20 " 64/68, "	"	112.60
12 " 20 " 84/92, "	"	105.65
14 " 20 " 84/92, "	"	142.35
Sewed buffs, per pound		
Bleached and unbleached	"	1.30

FELT WHEELS

			Price Per Lb.
White Spanish—			
Diameter— 8" to over 16"	Thickness—½" and ¾"		$4.00
" 8"	" 1" to 3"		3.35
" 10" to 16"	" 1" to 3"		3.25
" over 16"	" 1" to 3"		3.35
" 8" to over 16"	" over 3"		3.40
Grey Mexican—			
Diameter— 8" to over 16"	Thickness—½" and ¾"		$3.90
" 8"	" 1" to 3"		3.25
" 10" to 16"	" 1" to 3"		3.15
" over 16"	" 1" to 3"		3.25
" 8" to over 16"	" over 3"		3.30

Above are even diameters. Odd diameters 50c advance.